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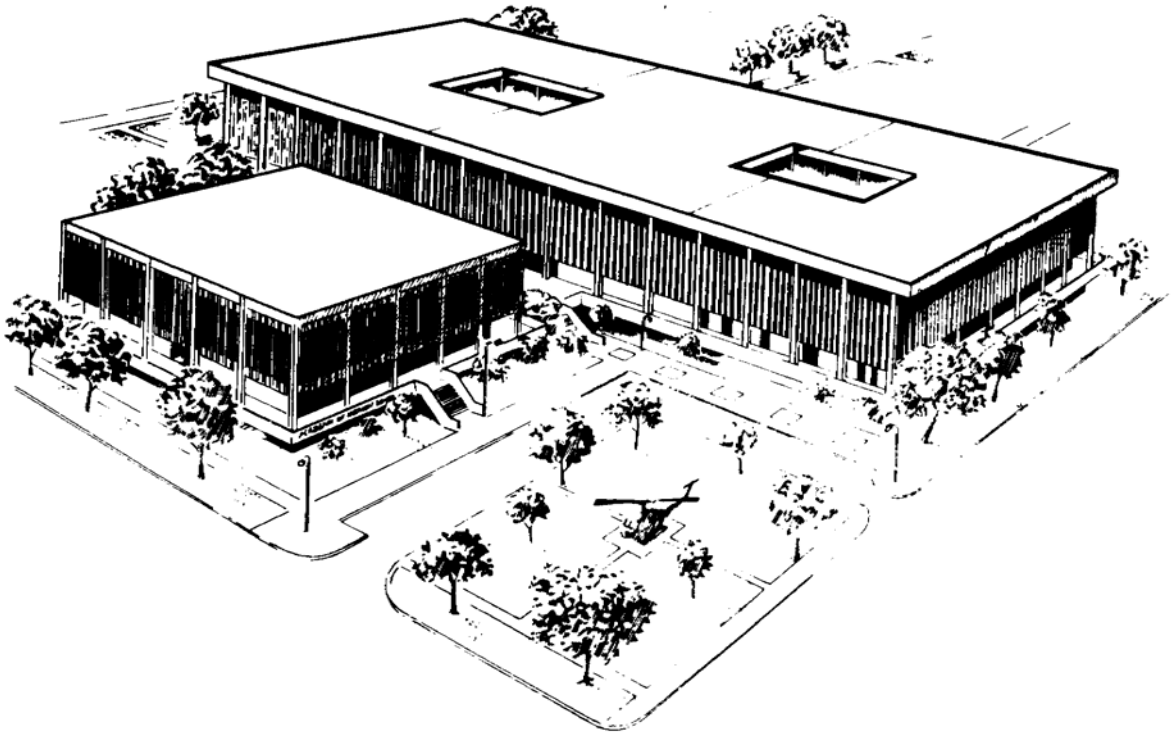
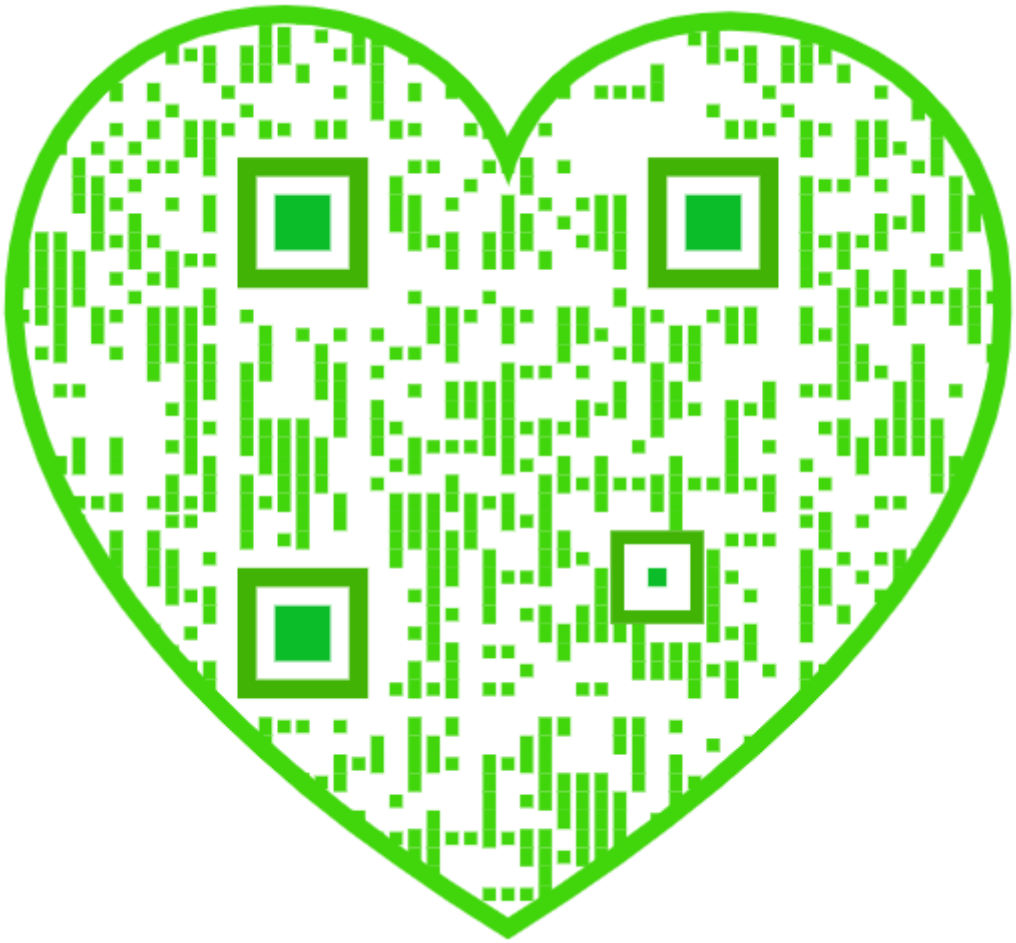


THE CENTRAL NERVOUS SYSTEM

SUBCOURSE MD0572 EDITION 100



DEVELOPMENT

This subcourse is approved for resident and correspondence course instruction. It reflects the current thought of the Academy of Health Sciences and conforms to printed Department of the Army doctrine as closely as currently possible. Development and progress render such doctrine continuously subject to change.

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CLARIFICATION OF TERMINOLOGY

When used in this publication, words such as "he," "him," "his," and "men" 'are intended to include both the masculine and feminine genders, unless specifically stated otherwise or when obvious in context.

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CORRESPONDENCE COURSE OF
THE U.S. ARMY MEDICAL DEPARTMENT CENTER AND SCHOOL

SUBCOURSE MD0572

THE CENTRAL NERVOUS SYSTEM

INTRODUCTION

The central nervous system is one of the two principal divisions of the body's nervous system. The nervous system is the body's communication network and control center. The central nervous system (CNS), consisting of the brain and the spinal cord, is the control center for the entire nervous system. All the sensations of the body are relayed to the central nervous system. All nerve impulses that cause muscles to contract and glands to secrete come from the central nervous system. As a medical NCO, it is of vital importance for you to understand the complex functions of the central nervous system.

Subcourse Components:

This subcourse consists of five lessons. The lessons are as follows:

- Lesson 1, Anatomy and Physiology of the Nervous System.
- Lesson 2, Physical Assessment of the Nervous System.
- Lesson 3, Central Nervous System Diseases and Disorders.
- Lesson 4, Seizures.
- Lesson 5, Central Nervous System Trauma.

Here are some suggestions that may be helpful to you in completing this subcourse:

--Read and study each lesson carefully.

--Complete the subcourse lesson by lesson. After completing each lesson, work the exercises at the end of the lesson, marking your answers in this booklet.

--After completing each set of lesson exercises, compare your answers with those on the solution sheet that follows the exercises. If you have answered an exercise incorrectly, check the reference cited after the answer on the solution sheet to determine why your response was not the correct one.

Credit Awarded:

Upon successful completion of this subcourse, you will be awarded 8 credit hours.

To receive credit hours, you must be officially enrolled and complete an examination furnished by the Nonresident Instruction Branch at Fort Sam Houston, Texas.

You can enroll by going to the web site http://atrrs.army.mil and enrolling under "Self Development" (School Code 555).

A listing of correspondence courses and subcourses available through the Nonresident Instruction Section is found in Chapter 4 of DA Pamphlet 350-59, Army Correspondence Course Program Catalog. The DA PAM is available at the following website: http://www.usapa.army.mil/pdffiles/p350-59.pdf.

LESSON ASSIGNMENT

LESSON 1	Anatomy and Physiology of the Nervous System.
LESSON ASSIGNMENT	Paragraphs 1-1 through 1-10.
LESSON OBJECTIVES	After completing this lesson, you should be able to:

1-1. Identify definitions of a neuron, nerve tissue, neuroglia, cell body, axon, dendrite, and synapse.

1-2. Identify the components of a neuron including the characteristics and functions of each.

1-3. Identify the types of neurons according to structure and function.

1-4. Identify the steps in the sequence of nerve impulse transmission.

1-5. Identify the locations of the major components of the central nervous system.

1-6. Identify the characteristics and functions of the major components of the central nervous system.

1-7. Identify the two subdivisions of the peripheral nervous system (PNS), including its characteristics, functions, and counter effects.

SUGGESTION After completing the assignment, complete the exercises of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 1

ANATOMY AND PHYSIOLOGY OF THE NERVOUS SYSTEM

1-1. INTRODUCTION

The nervous system facilitates contact of the individual with his external and internal environments and aids in appropriate responses to these constantly changing environments. A general knowledge of the anatomy of the nervous system and an understanding of its physiology will help you to recognize and treat injuries and diseases of the nervous system.

1-2. ROLE OF THE NERVOUS SYSTEM

a. The nervous system has three general functions that it performs in the role of the body's control center and communication network. The functions are:

(1) The nervous system is able to sense change both inside the body and change in the environment surrounding the body.

(2) The nervous system is able to interpret these changes.

(3) The nervous system causes the body to react to these changes by either muscular contraction or glandular secretion.

b. Homeostasis is a good example of the nervous system sensing change, interpreting change, and adjusting to change. (In homeostasis, the equilibrium of factors such as temperature, blood pressure, and chemicals are kept in relative balance.) In the case of homeostasis, the nervous system and the endocrine system operate together to maintain equilibrium in the body.

1-3. ORGANIZATION OF THE NERVOUS SYSTEM

The nervous system has two main divisions: the central nervous system (CNS) and the peripheral nervous system (PNS). The central nervous system is composed of the brain and the spinal cord. This system controls behavior. All body sensations are sent by receptors to the central nervous system to be interpreted and acted upon. All nerve impulses that stimulate muscles to contract and glands to secrete substances get the message from the central nervous system. The peripheral nervous system is composed of nerves. This system is a pathway to and from internal organs. PNS serves as a pathway to the brain for the five senses and helps humans adjust to the world around them. Further subdivision of the peripheral nervous system will be discussed later in this lesson.

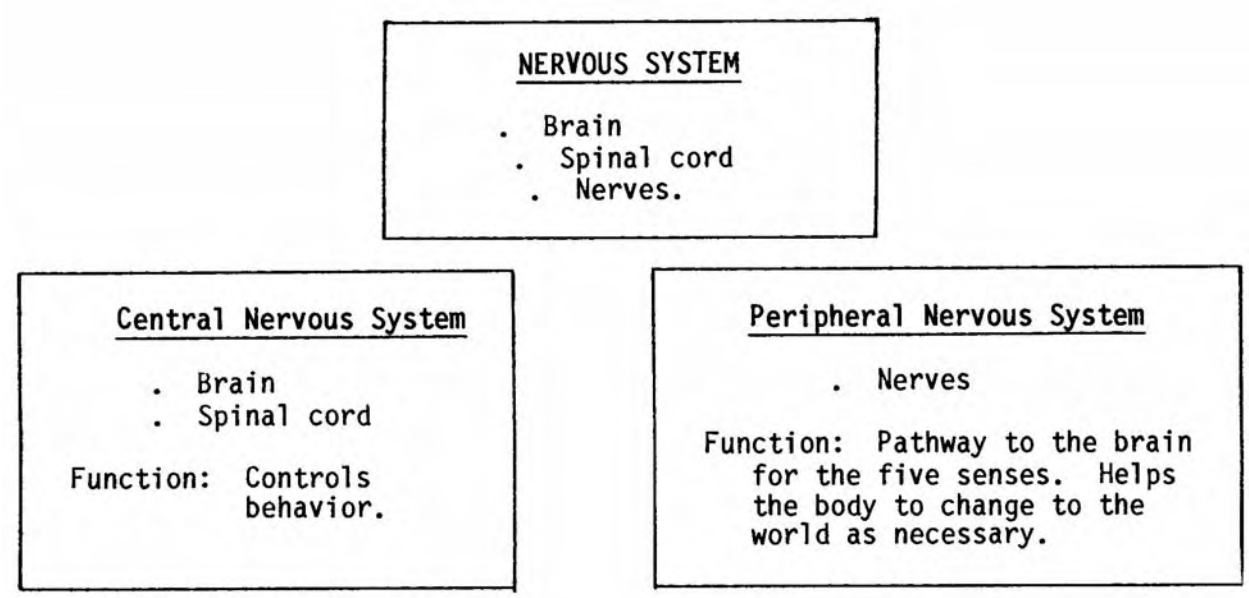
NERVOUS SYSTEM
. Brain
. Spinal cord
. Nerves.
Central Nervous System
. Brain
. Spinal cord
Function: Controls behavior.
Peripheral Nervous System
. Nerves
Function: Pathway to the brain for the five senses. Helps the body to change to the world as necessary.

Figure 1-1. Organization of the nervous system.

1-4. CELL ORGANIZATION OF THE NERVOUS SYSTEM

Only two principal kinds of cells exist in the nervous system: neurons and neuroglia. Neuroglia cells (also called glial cells) act as connective tissue and function in the roles of support and protection. Some of these cells twine around nerve cells or line certain structures in the brain and spinal cord. Other neuroglia cells bind nervous tissue to supporting structures and attach neurons to their blood vessels. Other small neuroglia cells protect the central nervous system from disease by surrounding invading microbes and clearing away debris. Clinically, these cells are important because they are a common source of tumors of the nervous system. Neuron cells are nerve cells, the basic unit that carries out the work of the nervous system. Impulses from one body part to another body part are conducted by neurons.

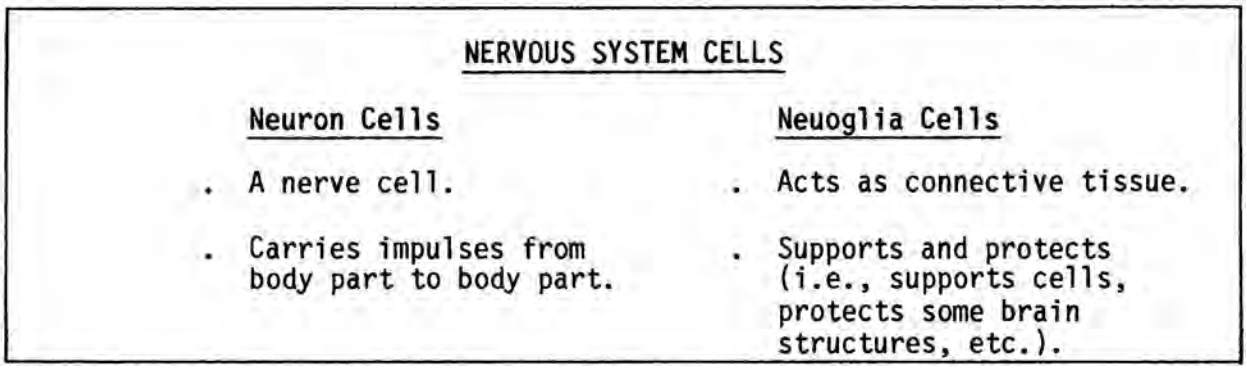
NERVOUS SYSTEM CELLS
Neuron Cells
. A nerve cell.
. Carries impulses from body part to body part.
Neuoglia Cells
. Acts as connective tissue.
. Supports and protects (i.e., supports cells, protects some brain structures, etc.).

Figure 1-2. Cells of the nervous system.

1-5. COMPONENTS OF NEURONS

The neuron, the basic unit that carries out the work of the nervous system, is a specialized conductor cell that receives and transmits electrochemical nerve impulses. In other words, neurons are nerve cells that conduct impulses from one body part to another body part. Each neuron is made up of three distinct parts: the cell body, dendrites, and an axon.

a. **Cell Body, Dendrites, and Axon.** The cell body contains a nucleus or control center. Also, a neuron usually has several highly branched, thick extensions of cytoplasm called dendrites. The exception is a sensory neuron that has a single, long dendrite instead of many dendrites. At the other extreme are motor neurons, each of which has many thick "tree-like" dendrites. The dendrite's function is to carry a nerve impulse toward the cell body. An axon is a long, thin process that carries impulses away from the cell body to another neuron or tissue. There is usually only one axon per neuron. Axons vary in length and diameter and are "jelly-like" in appearance.

b. **Myelin Sheath (Schwann Cells).** The myelin sheath is a white segmented covering made up of Schwann cells. The covering is around axons and dendrites of many peripheral neurons. This covering wraps around the entire axon in "jelly-roll" fashion, except at the point of termination and at the nodes of Ranvier. (The nodes of Ranvier are intermittent constrictors along the myelin sheath.) The myelin sheath is made up of a layer of protein, two layers of lipids or fats, and one more layer of protein.

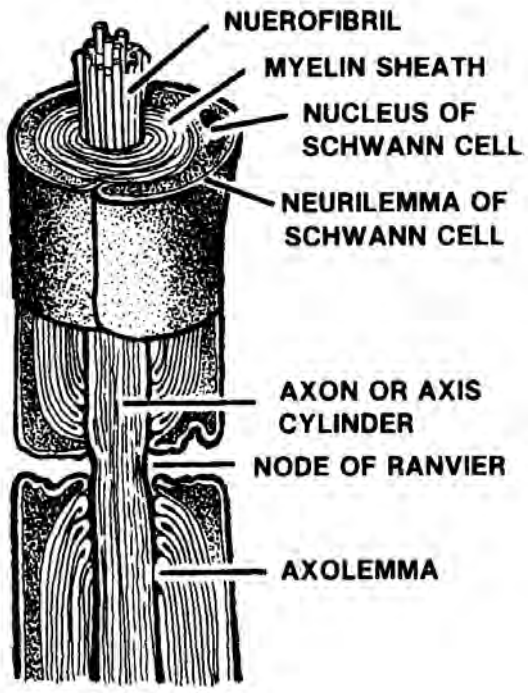

Figure 1-3. Sections of a myelinated fiber.

c. **Neurilemma.** The neurilemma is the nucleated cytoplasmic layer of the Schwann cell. The neurilemma allows damaged nerves to regenerate. Nerves in the brain and spinal cord DO NOT have a neurilemma and, therefore, DO NOT recover when damaged.

1-6. TYPES OF NEURONS

Neurons in the body can be classified according to structure and function. Classification by structure is based on the number of processes (projections or protrusions) extending from the cell body. Neurons are classified by functions according to the direction in which the neurons transmit impulses.

a. **Classification of Neurons by Structure.** Classifications are as follows: multipolar neurons, bipolar neurons, and unipolar neurons. Multipolar neurons have one axon and several dendrites. Brain and spinal cord neurons are generally multipolar neurons. Bipolar neurons have one axon and one dendrite. Most of these neurons are found in the retina of the eye, the inner ear, and the olfactory area. Neurons with only one process extending from the cell body are termed unipolar neurons. The one process divides with one part acting as an axon and the other part functioning as a dendrite. Unipolar neurons are found in the posterior (sensory) root ganglia of the spinal nerves.

b. **Classification of Neurons by Function.** According to function, there are two types of neurons: sensory neurons (also called afferent neurons) and motor neurons (also called efferent neurons). Sensory neurons conduct impulses from the receptors in the skin, sense organs, and viscera (the large internal organs) to the brain and the spinal cord. These neurons conduct impulses from receptors to the central nervous system and are usually unipolar. Impulses transmitted from the brain and spinal cord to either muscles or glands are carried by motor neurons. These neurons conduct information away from the central nervous system to the skin, muscles, glands, and organs of the body.

1-7. REFLEX ARC

An impulse follows a conduction pathway from its origin in the dendrites or neuron cell body in one part of the body to the impulse's end somewhere else in the body. One pathway is called a reflex arc and is a functional unit of the nervous system. The basic parts of a reflex arc are a receptor, a sensory neuron, a center, a motor neuron, and an effector.

a. **Function of Components of a Reflex Arc.** Functions are:

(1) Receptor. The receptor activates a nerve impulse in a sensory neuron in response to a change in the body's internal or external environment.

(2) Sensory neuron. This neuron conducts the impulse from the receptor to its axonal end in the central nervous system.

(3) Center. This is a receiving area (usually in the central nervous system) in which the incoming sensory impulse connects with an outgoing motor impulse. The impulse may be repressed, transmitted, or rerouted in the center area.

(4) Motor neuron. The job of the motor neuron is to transmit the impulse to the proper body organ.

(5) Effector. The effector is the organ of the body that responds to the impulse from a motor neuron. An effector may be either a muscle or a gland.

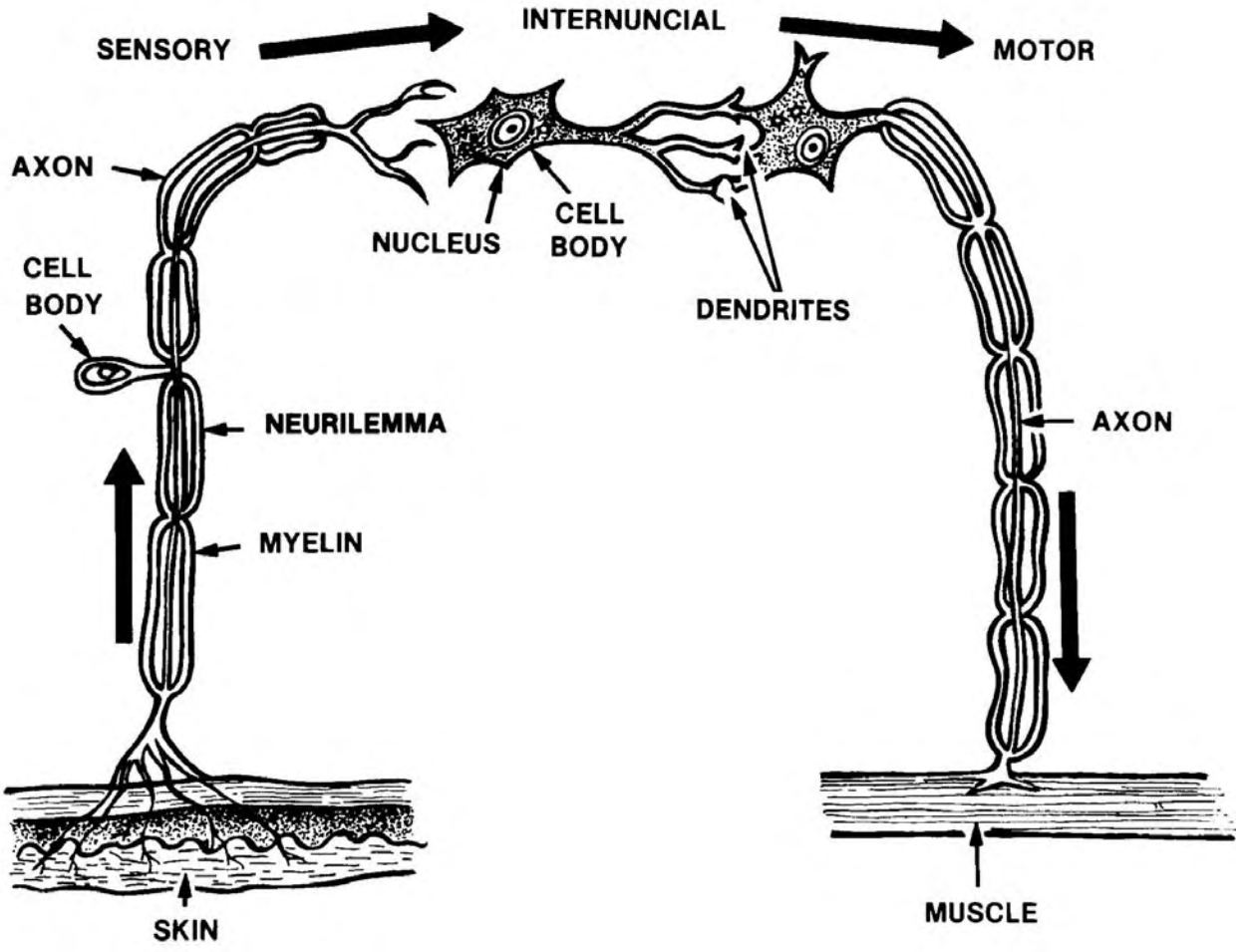

Figure 1-4. The pathway of an impulse over the reflex arc.

1-8. NERVE IMPULSE TRANSMISSION

A nerve impulse is an electro-negative wave that travels over the cell's membrane. To understand the way in which a nerve impulse travels, follow this example of a hand touching a match:

a. The hand touches a lighter match -- stimulus.

b. A dendrite receives the impulse from the skin. The impulse is then transmitted over each neuron as follows:

(1) Cell body.

(2) Axon.

(3) Axon terminals.

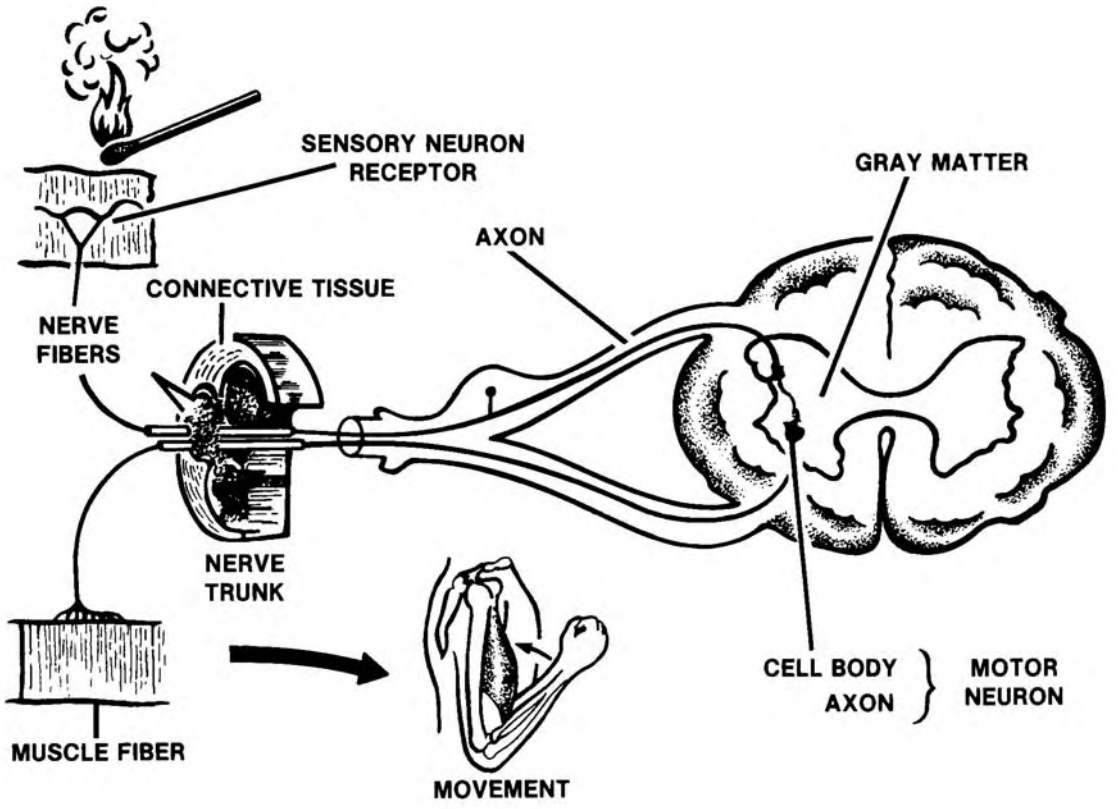

Figure 1-5. The transmission of a nerve impulse.

(4) Synapse. Synapse is the junction between two neurons where the electrical activity in one neuron influences the excitability of the second neuron. At this point (the synapse), a chemical reaction occurs.

(a) Acetylcholine (excitor). This is the chemical transmitter of a nerve impulse across a synapse. Acetylcholine is a nerve transmitter stored in synaptic vesicles. This transmitter is the major neurotransmitter in the efferent divisions of the peripheral nervous system.

(b) Acetylcholinesterase (inhibitor). Also called cholinesterase, this enzyme is located on the postsynaptic membrane that destroys acetylcholine.

c. The impulse continues to the next dendrite, in a chain reaction.

d. The hand jerks away -- response.

1-9. MAJOR COMPONENTS OF THE CENTRAL NERVOUS SYSTEM

a. **Brain.** The brain fills the cranium and weighs about three pounds in the average adult. The brain is shaped like a mushroom. The brain consists of four principal parts: the brain stem, the diencephalon, the cerebrum, and the cerebellum. The diencephalon, also known as the forebrainstem, includes the thalamus and hypothalamus.

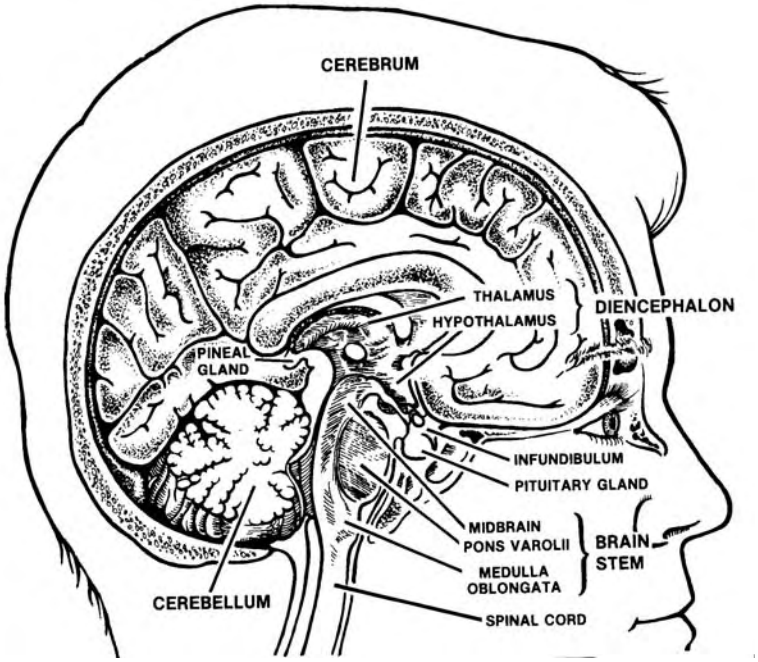

Figure 1-6. Principal parts of the brain.

(1) Brain matter. There are two types of matter in the brain: gray matter and white matter. Gray matter is in the active portion of the brain. Gray matter receives and stores impulses. Answering impulses originate in the brain's gray matter. Cell bodies of neurons and neuroglia are in the gray matter. White matter in the brain carries impulses to and from gray matter. White matter is composed of nerve fibers (axons).

(2) Cerebrum. The cerebrum forms the bulk of the brain and is supported on the brain stem. The cerebrum is divided into two hemispheres. Each hemisphere controls the activities of the side of the body opposite that hemisphere. Each hemisphere is further subdivided into four lobes:

(a) Frontal lobe. This lobe is responsible for voluntary motor function (origin of pyramidal motor system) and higher mental functions such as judgment and foresight, affect, and personality.

(b) Temporal lobes. These lobes are responsible for hearing, speech in the dominant hemisphere, vestibular sense, behavior, and emotion.

(c) Parietal lobe. This lobe is responsible for sensory function, sensory association areas, higher level processing of general sensory modalities, e.g., stereognosis -- recognizing the size and shape of objects by the sense of touch.

(d) Occipital lobe. This lobe is responsible for vision.

(3) Cerebellum. The cerebellum is located behind and below the cerebrum. Its functions include the following:

(a) Awareness of posture, movement, and voluntary muscle movement; for example, equilibrium.

(b) Receipt of relayed tactile, auditory, and visual input; for example, processing of information obtained by what you see and hear.

(c) Fine motor coordination; for example, writing.

(4) Midbrain. The midbrain is located above the pons, extending from the pons to the lower part of the diencephalon. The midbrain provides conduction pathways to and from higher and lower centers. The righting, postural, and audiovisual reflexes are reflex centers located in the midbrain. The righting reflex helps keep the head right-side up. Postural reflexes deal with positioning the head in relation to the trunk of the body. Visual and auditory reflexes cause you to respond by turning your head in the direction of a loud noise.

(5) Pons. The pons is located anterior and slightly superior to the cerebellum and between the midbrain and the medulla. The pons acts as a pathway to higher structures. It contains conduction pathways between the medulla and higher brain centers. It also serves to connect the two halves of the cerebellum. There is a respiratory center in the pons which prolongs inspiration (breathing in). The beginnings of some cranial nerves are in the pons.

(6) Medulla oblongata (brain stem). This part of the brain is an expanded continuation of the spinal cord. The brain stem is located between the pons and the spinal cord and is only about one inch long. Contained in the brain stem are the centers for the regulation of respirations, heartbeat, and basomotor activators. These centers are often called the vital centers because they are essential to life. Some nerves cross over at the medulla oblongata which explains why one side of the brain controls activities on the opposite side of the body.

(7) Thalamus. The thalamus is located in the walls of the third ventricle of the brain and is the area of arousal and conscious recognition of crude sensations; for example, temperature and pain. Sensory and afferent impulses go to the thalamus and are sorted and grouped there. Next, these impulses are sent to the proper area of the cerebral cortex where the impulses are interpreted. According to the Law of Specific Nerve Energies, the place at which an impulse ends in the thalamus determines the sensation to be felt. For example, if the impulse ends in the heat area of the thalamus, the individual feels heat.

(8) Hypothalamus. The hypothalamus is a small part of the diencephalon. This portion of the brain has several functions. It monitors the chemical composition of blood. The hypothalamus acts as a relay station between the cerebrum and the lower autonomic centers. It controls hormone secretion by the pituitary gland and also controls the appetite.

b. **Spinal Cord.** The spinal cord is a cylindrical structure which extends from the foramen magnum through the spinal foramina of the vertebral column to the upper portion of the lumbar region. Extension varies from the 12th thoracic vertebra to the 2nd lumbar vertebra. The length of the cord remains fairly constant in adults: 18 inches in males and 16 inches in females. The conus medullaris is the cone-shaped termination of the cord. This portion of the spinal cord weighs about one ounce and is approximately one and one-half inches wide. The spinal cord itself appears wider from right to left than from anterior to posterior. The size and shape, however, do vary depending on the vertebral region. For example, the spinal cord presents cervical and lumbar enlargements, which are areas of nerve origin in the upper and lower lumbar region. The spinal cord is composed of a series of 31 segments. A pair of spinal nerves comes out of each segment. The region of the spinal cord from which a pair of spinal nerves originates is called the spinal segment. Both motor and sensory nerves are located in the spinal cord.

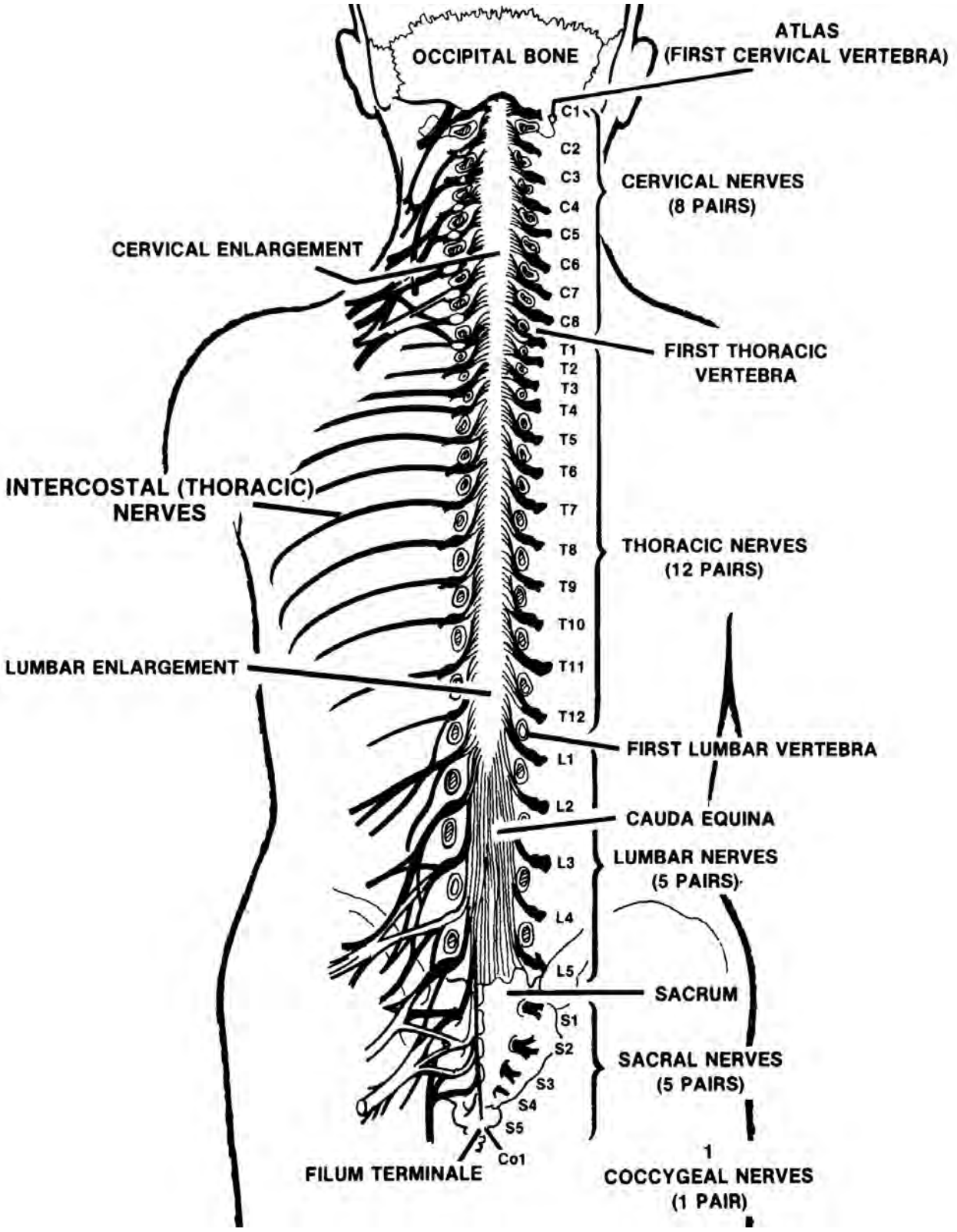

Figure 1-7. Spinal cord and spinal nerves.

c. **Meninges.** The meninges are the three membranes that envelop the brain and the spinal cord. The outermost layer is the dura mater. The middle layer is the arachnoid, and the innermost layer is the pia mater. These three spinal meninges cover the spinal nerves to the point where the spinal column goes through the intervertebral foramen. The meninges offer protection to the brain and the spinal cord by acting as a barrier against bacteria.

d. **Cerebrospinal Fluid (CSF).** The cerebrospinal fluid protects the brain against injury. CSF circulates through the subarachnoid space (the area between the arachnoid and pia mater), around the brain and spinal cord and through the ventricles of the brain. In addition to protecting the brain, this clear fluid nourishes the central nervous system and carries off wastes.

1-10. PERIPHERAL NERVOUS SYSTEM (PNS)

The peripheral nervous system (PNS) is composed of nerves that connect the central nervous system to remote parts of the body, relaying and receiving messages from these parts of the body. This system is a pathway to the brain for the five senses which help us respond to the world around us. The peripheral nervous system is divided into the cerebrospinal nervous system and the autonomic nervous system (ANS).

a. **Cerebrospinal Nervous System.** This system is composed of 12 pairs of cranial nerves. The cranial nerves are symmetrically arranged and attached to the brain. Each cranial nerve leaves the skull through a foramen (an opening) at its base. The nerves are numbered in the order in which they emerge from the opening and from front to back. The numbered nerves along with the function of each nerve are given in table 1-1.

I	Olfactory.	Smell
II	Optic.	Sight

NOTE: Neither the olfactory nor the optic nerves are really cranial nerves since these nerves are composed of fibers belonging to the central nervous system.

III	Oculomotor	Movement of the eyeball, lens, and pupillary sphincter
IV	Trochlear	Superior oblique muscle of the eye
V	Trigeminal	Affects ophthalmic, maxillary, and mandible areas; controls muscles of mastication
VI	Abducens	Moves the eye outward
VII	Facial	Controls muscles of the face, scalp, ears; controls salivary glands; receives taste sensation from the anterior 2/3 of the tongue
VIII	Acoustic	Hearing and equilibrium
IX	Glossopharyngeal	Sensations from the pharynx and the posterior 1/3 of the tongue
X	Vagus	Sensory and motor to thoracic and abdominal viscera
XI	Accessory	Permits movement of head and shoulders
XII	Hypoglossal	Controls muscles of tongue

Table 1-1. 12 pairs of cranial nerves and their functions.

b. **Spinal Nerves.** There are 31 pairs of spinal nerves. They are named for the region from which they leave the spinal canal through the intravertebral foramina. Included are 8 pairs of cervical nerves, 12 pairs of thoracic nerves, 5 pairs of lumbar nerves, 5 pairs of sacral nerves, and 1 pair of coccygeal nerves. Fibers from the spinal nerves extend to all muscles of the trunk of the body and to the extremities. These fibers carry impulses between the spinal cord and the skin, muscles, and other structures. Each spinal nerve is derived from the spinal cord by two roots: a sensory (dorsal) root and a motor (ventral) root.

c. **Autonomic Nervous System (ANS).** This system regulates the action of secretory activity of glands and the involuntary contraction of smooth muscle, as in the blood vessels, the skin, the heart, and the bronchial tubes. The autonomic nervous system usually operates without conscious control. Originally, the system was named automatic because physiologists thought the system functioned completely automatically --that is, without any control from the central nervous system. Currently, it is believed that the ANS is structurally and functionally dependent on the central nervous system. The autonomic nervous system is subdivided into two systems that counteract each other: the sympathetic system and the parasympathetic system.

(1) Sympathetic system. This system generally increases the activity of the body. The sympathetic system prepares the body to meet danger or undergo strenuous physical activity. The system responds to stimuli by releasing adrenalin (epinephrine) or acetylcholine into the body, thus, making the individual feel that he has extra energy to flee or fight.

(2) Parasympathetic system. This system acts in opposition to the sympathetic system and maintains homeostasis (maintenance of a relatively constant body internal environment). The parasympathetic system exercises nonstress situational controls on the internal organs of the body allowing the body to rest and repair. To this end, cholinesterase, a substance which counteracts the effects of acetylcholine, is replaced.

NOTE: The two systems, the sympathetic system and the parasympathetic system, work in opposition to each other to give the body protection.

Continue with Exercises

EXERCISES, LESSON 1

INSTRUCTIONS. The following exercises are to be answered by writing the answer in the space provided. After you have completed all the exercises, turn to Solutions to Exercises at the end of the lesson and check your answers.

1. List two roles of the central nervous system.

   a. _____.

   b. _____.

2. List the two major parts of the central nervous system.

   a. _____.

   b. _____.

3. A major function of the _____is to control behavior.

4. The two types of cells in the nervous system are _____ and

   _____ cells.

5. The nervous system cells which carry impulse from one body part to another

   body part are _____ cells.

6. What is the function of a dendrite? _____

   _____.

7. The function of an axon is to _____.

8. The white segmented covering around axons and dendrites is called

   _____.

9. Multipolar neurons, bipolar neurons, and unipolar neurons are neurons which are classified by _____

10. A _____ activates a nerve impulse in a sensory neuron in response to a change in the body's environment.

11. List the four principal parts of the brain.

    a. _____.

    b. _____.

    c. _____.

    d. _____.

12. _____ matter, the active portion of the brain, receives and stores impulses.

13. The portion of the brain which sorts out sensory and afferent impulses is the _____

14. The eight pairs of cervical nerves, the 12 pairs of thoracic nerves, the 5 pairs of lumbar nerves, and the 5 pairs of sacral nerves are all part of the _____.

15. List three functions of cerebrospinal fluid (CSF).

    a. _____.

    b. _____.

    c. _____.

16. List three functions of the autonomic nervous system.

    a. _____.

    b. _____.

    c. _____.

17. The sympathetic nervous system generally increases the activity of the body, and the _____ system acts in opposition to the sympathetic system, allowing the body to rest and repair itself.

18. The twelfth nerve in the cerebrospinal nervous system (the hypoglossal nerve) controls the _____.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 1

1. The body's communication center.
   The body's control center. (para 1-2)

2. The brain.
   The spinal cord. (para 1-3)

3. Central nervous system. (para 1-3)

4. Neurons.
   Neuroglia. (para 1-4)

5. Neuron. (para 1-4)

6. Dendrites carry impulses away from the cells. (para 1-5a)

7. Carry impulses away from the cell body to another neuron or tissue. (para 1-5a)

8. Myelin sheath. (para 1-5a)

9. Structure. (para 1-6b)

10. Reflex arc. (para 1-7a(1))

11. The brain stem.
    The diencephalon.
    The cerebrum.
    The cerebellum. (para 1-9)

12. Gray. (para 1-9a(1))

13. Thalamus. (para 1-9a(7))

14. Spinal cord. (para 1-9b; figure 1-7)

15. Protects the brain against injury.
    Nourishes the central nervous system.
    Carries off wastes. (para 1-9d)

16. Regulates cardiac muscle activities.
    Regulates smooth muscle activities.
    Regulates glandular secretions. (para 1-10b)

17. Parasympathetic. (para 1-10b(2))

18. Muscles of the tongue. (para 1-10a)

End of Lesson 1

LESSON ASSIGNMENT

LESSON 2	Physical Assessment of the Nervous System.
LESSON ASSIGNMENT	Paragraph 2-1 through 2-5.
LESSON OBJECTIVES	After completing this lesson, you should be able to:

2-1. Identify common malfunctions of the central and peripheral nervous systems.

2-2. Identify information that should be obtained from a generalized neurological examination.

2-3. Identify the procedures for a detailed neurological examination, including the diagnostic procedures involved with each.

SUGGESTION After completing the assignment, complete the exercises of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 2

PHYSICAL ASSESSMENT OF THE NERVOUS SYSTEM

2-1. INTRODUCTION

The human nervous system is highly complex and very difficult to evaluate. You will undoubtedly have numerous opportunities to evaluate patients with neurological complaints or injuries. A basic understanding of the essentials of the neuropsychiatric examination is necessary to enable you to do this.

2-2. COMMON MALFUNCTIONS

A variety of malfunctions can occur in the nervous system. Problems can take place in the central nervous system as well as in the peripheral nervous system.

a. **Central Nervous System.** In the brain, there can be interference of nerve impulses, impairment of autonomic functions, impairment of thinking processes, impairment of seeing, hearing, and speaking, and impairment of muscle coordination. In the spinal cord, possible problems include impairment of the spinal cord reflex arc, impairment of touch, and impairment of movement.

b. **Peripheral Nervous System.** Problems in this area include the reduction or elimination of stretch reflexes; for example, a reduction in the range of motion of a body part. Another possible malfunction in this system is nerve paralysis.

2-3. GENERALIZED NEUROLOGICAL EXAMINATION COMPONENTS

Many patients will not require a detailed neurological examination, but a generalized neurological examination may be helpful. A simple means of gathering a great deal of information about the patient's neurological system is to observe the patient walking, talking, seeing, and hearing. Watching the patient enter the room is also important in giving the examiner information. As the patient enters the room, check the following:

a. Posture and motor behavior.

b. Dress, grooming, and personal hygiene.

c. Facial expression.

d. Speech.

e. Manner, mood, and relation to persons and things around him.

NOTE: A person who has previously been well-groomed and now has poor personal hygiene, lack of concern for appearance, and inappropriate clothing for the time of year may have an emotional problem, a psychiatric disturbance, or an organic brain syndrome.

2-4. DETAILED NEUROLOGIC EXAMINATION

A more complete and specific neurologic examination is necessary to confirm a diagnosis in a suspected neurologic disorder. Areas to be evaluated in such an examination include mental status, motor function, sensory function, and reflexes.

a. **Mental Status.**

(1) Level of consciousness. The single most valuable indicator of neurologic function is the individual's level of consciousness. Determine the patient's level of consciousness -- alert, lethargic, stupor, semicoma, or coma.

NOTE: Legally, only physicians are authorized to make such determinations. You can legally describe the patient's condition in the nursing notes by saying, "appears to be" alert or lethargic or so forth.

(a) Alert. The patient is awake and verbally and motorally responsive.

(b) Lethargic. The patient is sleepy or drowsy and will awaken and respond appropriately to command.

(c) Stupor. The patient becomes unconscious spontaneously and is very hard to awaken.

(d) Semicoma. The patient is not awake but will respond purposefully to deep pain.

(e) Coma. The patient is completely unresponsive.

(2) Calculations in basic mathematics. Ask the patient to do some simple arithmetic problems without using paper and pencil. For example, ask him to add 7s or to subtract 3s backwards. It should take the patient of average intelligence about one minute to complete the calculations with few errors.

(3) Affect/mood. During the physical part of the examination, note the patient's mood and emotional expressions which you can observe by his verbal and nonverbal behavior. Notice if he has mood swings or behaves as though he is anxious or depressed. Notice whether or not the patient's feelings are appropriate for the situation. Disturbances in mood, affect, and feelings may be indicated by a patient who exhibits unresponsiveness, hopelessness, agitation, euphoria, irritability, or wide mood swings.

(4) Memory (recent and remote). Ask the patient his social security number, the city he is in, the building number, the state, and the names of two or three past presidents of the United States.

(5) Knowledge (normal intellect). Ask the patient to name five large cities, major rivers, etc. Another way to test this area is to ask the patient to tell you the meaning of a fable, proverb, or metaphor. For example, explain:

(a) Too many cooks spoil the soup.

(b) A penny saved is a penny earned.

(c) A stitch in time saves nine.

A person of average intelligence should be able to explain any of these phrases. A person who can't explain any of these phrases may have organic brain syndrome, brain damage, or lack of intelligence.

b. **Cerebellar Functions.** These include tests for balance and coordination. The cerebellum controls the skeletal muscles and coordinates voluntary muscular movement.

(1) Finger-to-nose test. With his eyes open, instruct the patient to touch his index finger to his nose.

(2) Rapid alternating movements test. Seat the patient. Instruct him to pat his knees with his hands, palms down then palms up. Have him alternate palms down and palms up rapidly. Watch the patient to notice if his movements are stiff, slow, nonrhythmic, or jerky. The movements should be smooth and rhythmic as he does the task faster.

(3) Romberg test. Instruct the patient to stand with his feet together and his arms at his side. Have the patient do this with his eyes open and then with his eyes closed. (Stand close to the patient to keep him upright if he starts to sway.) Expect the patient to sway slightly but not fall. This is a test of balance. If the patient really loses his balance, he may have cerebellar ataxia or vestibular dysfunction.

Figure 2-1. The Romberg test for balance.

(4) Normal gait and heel-toe-heel walking. To check the patient for normal gait, have him walk around the examining room. He should walk in his gait with appropriate arm movements:

(a) The heel of one foot hits the floor, and then the foot is on the floor completely.

(b) The heel of the other foot pushes off and leaves the floor.

(c) The patient transfers his weight from the first heel to the ball of his foot.

(d) He swings the first leg faster as he takes his weight off his second foot.

Figure 2-2. Normal gait.

(e) The second foot moves more slowly as it gets ready for his heel to strike the floor.

NOTE: In this process, observe whether the patient shuffles, places his feet too wide apart, walks on his toes, has foot flop and leg lag or scissoring, doesn't swing his arms, staggers, or reels. The way he walks should be smooth with a regular rhythm and a symmetric stride length. The trunk should sway slightly, and his arm swing should be smooth and symmetric.

c. **Motor Function.** Perform the following checks:

(1) Check for mild weakness. Have the patient stand with his arms outstretched, palms upward, eyes closed for 20 to 30 seconds. If one arm drops and the hand turns over slightly, he has mild weakness called the pronator sign.

(2) Check muscle tone. Instruct the patient to relax. If the patient is in bed, lift one of his limbs from the bed and watch it fall. When the patient sits on the edge of the examining table, the freedom with which the legs swing indicates the muscle tone.

(3) Check muscle strength. Instruct the patient to do the following:

(a) Ask him to grip your hands and squeeze.

(b) Have the patient push against your palm with his foot. Compare the strength of his muscles on each side of his body.

(c) Have the patient extend and flex his neck, elbows, wrists, fingers, toes, hips, and knees.

(d) Instruct him to extend his spine.

(e) Ask the patient to contract and relax his abdominal muscles.

(f) Have him rotate his shoulders.

(g) Instruct the patient to walk on his toes, then to walk on his heels.

NOTE: Test the patient bilaterally (comparing muscle strength on one side of the body with muscle strength on the other side of the body). Look for muscle atrophy (loss of muscle strength or muscle tone).

d. **Cranial Nerves.** Evaluating the cranial nerves is an important part of the neurologic examination. Taste and smell are usually not checked unless a problem is suspected in those areas. Test the patient's pupillary reflexes. This is commonly done by shining a light in the patient's eyes and comparing the eyes. The pupillary reflexes are abnormal if they do not respond to light or if the pupils respond unequally. If the pupillary reflex in both eyes are equal, write PERRLA (pupils equal round and reactive to light and accommodation). Instruct the patient to smile and raise his eyebrows. Look for weakness or drooping on either side of his face while he is smiling. Check to see if there is even movement of both eyebrows.

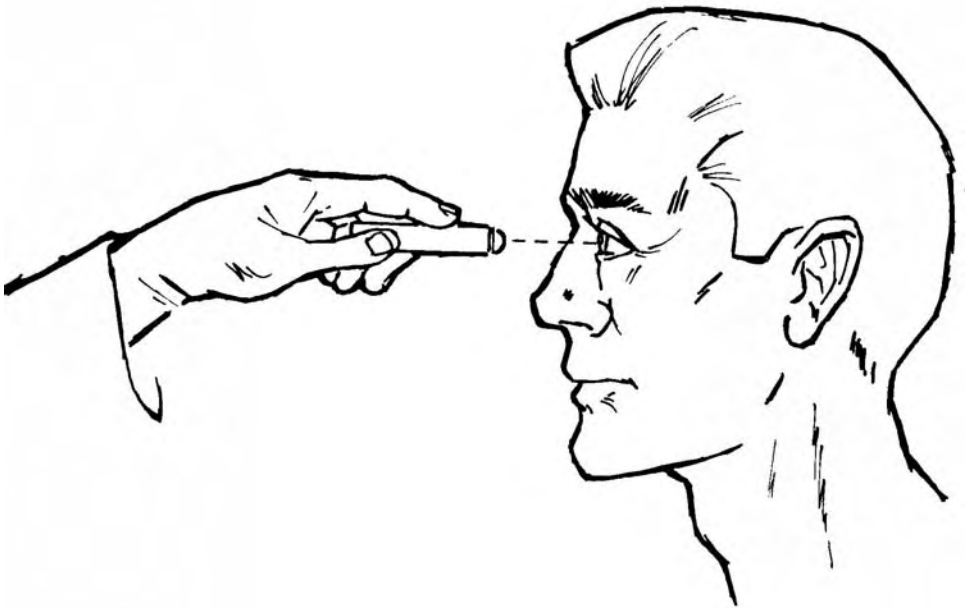

Figure 2-3. Testing for pupillary reactions.

e. **Sensory Function.** Testing for sensory function is the most difficult and the least reliable part of the examination. Perform two tests.

(1) Test for pain. Perform this test using pin pricks in the arms and legs. Ask the patient to say "sharp" or "dull" after each stimulus and to reply immediately. This is a test of the patient's response to superficial pain. Usually, a sterile needle with a sharp point and dull hub on the other end is the instrument used. In a nonpredictable pattern, touch the patient's skin with one or the other end of the needle.

Figure 2-4. Testing for pain.

(2) Test for touch. Touch the skin with a cotton ball using light strokes. Do not press down on the skin or touch areas of the skin that have hair. Instruct the patient to point to the area you have touched or tell you when he feels the sensation of being touched. (Obviously, he will not be watching you touch his skin.)

Figure 2-5. Testing for touch.

f. **Reflexes.** A reflex may be defined as an immediate and involuntary response to a stimulus. A reflex is a fast response to a change in the body's internal or external environment in an attempt to restore homeostasis.

(1) Reflexes and diagnosis. Evaluation of a reflex can aid a doctor in diagnosing a problem. A reflex which stops functioning or functions abnormally may indicate that a particular conduction pathway in the body has been damaged. Testing internal organs for reflex is not practical for diagnosis, but somatic reflexes (reflexes resulting in the contraction of skeletal muscles) are excellent diagnostic tools.

(2) Superficial reflexes. Stroke the skin with a hard object such as an applicator stick. What is felt is a superficial reflex.

(3) Muscle reflexes. Muscle reflexes help determine how responsive the spinal cord is. If many impulses are transmitted from the brain to the spinal cord, the muscle reflexes become so sensitive that just tapping the tendon of the knee with the tip of your finger can cause the leg to jump a considerable distance. If, however, the cord is overwhelmed by other impulses from the brain, it may be impossible to cause the muscles or tendons to respond.

(4) Evaluation of neurological impairment. You can evaluate neurological impairment by testing reflexes using a stopwatch to time the reflex response. These are reflexes that are clinically significant:

(a) Biceps--deep tendon reflex.

1 Have the patient's elbow at about a 90E angle of flexion with the arm slightly bent down as shown in figure 2-6.

2 Grasp the elbow with your left hand so the fingers are behind the elbow and your abductee thumb presses the biceps brachii tendon.

3 Strike your thumb a series of blows with the rubber hammer, varying your thumb pressure with each blow until the most satisfactory response is obtained.

4 Normal reflex is elbow flexion (bending).

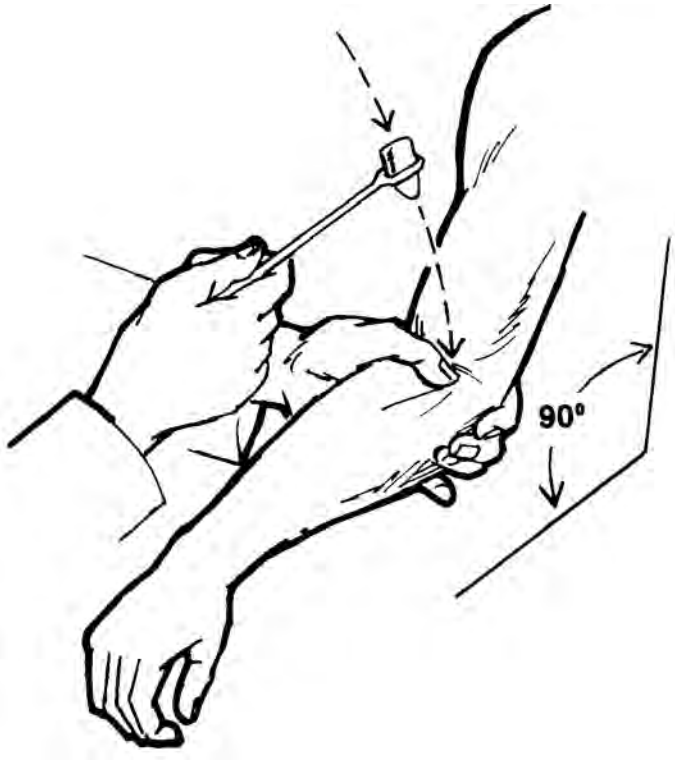

Figure 2-6. Biceps reflex.

(b) Triceps--deep tendon reflex.

1 Grasp the patient's wrist with your left hand and pull his arm across his chest so the elbow is flexed about 90E and the forearm is partially bent down.

2 Tap the triceps brachii tendon directly above the olecranon process. The normal response is elbow extension.

Figure 2-7. Triceps reflex.

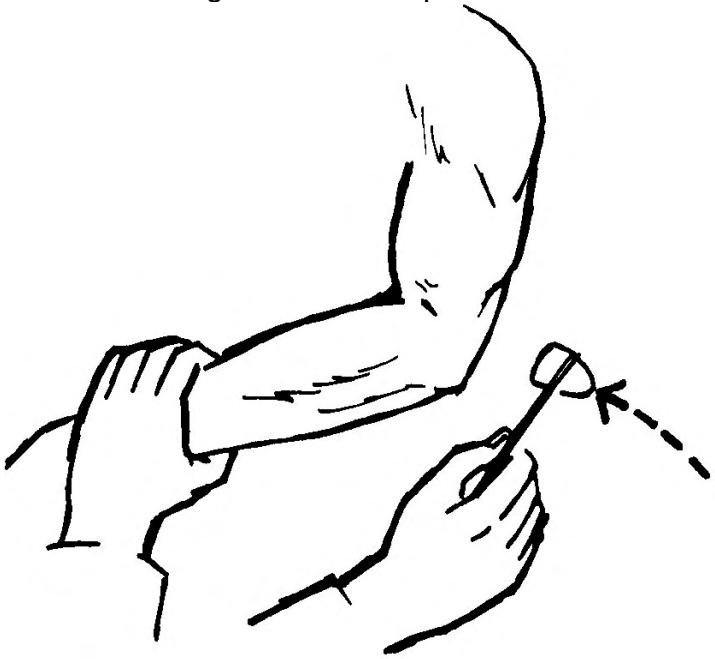

Figure 2-8. Triceps jerk with one arm flexed.

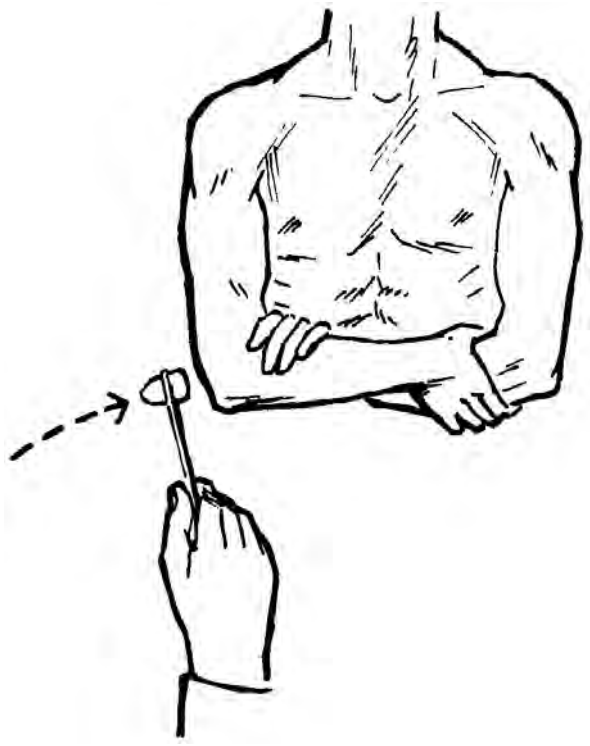

Figure 2-9. Triceps jerk with arms folded.

(c) Plantar (Babinski) reflex. Lightly stimulate the outer margin of the sole of the foot to get this reflex. Perform the reflex check in this manner:

1 Grasp the ankle with your left hand.

2 Use a blunt point and moderate pressure and stroke the sole of the foot near its lateral border. Stroke from the heel toward the ball of the foot where the course should curve across the ball of the foot to the medial side, following the bases of the toes.

3 A normal reflex is for the patient to have plantar flexion of all his toes.

4 A completely abnormal reflex is indicated if there is dorsiflexion (turning upward) of the big toes, fanning of all toes, turning upward of the ankle, or flexion (bending) of the knee and hip.

NOTE: Those patients who are extremely ticklish may have a slightly abnormal reflex.

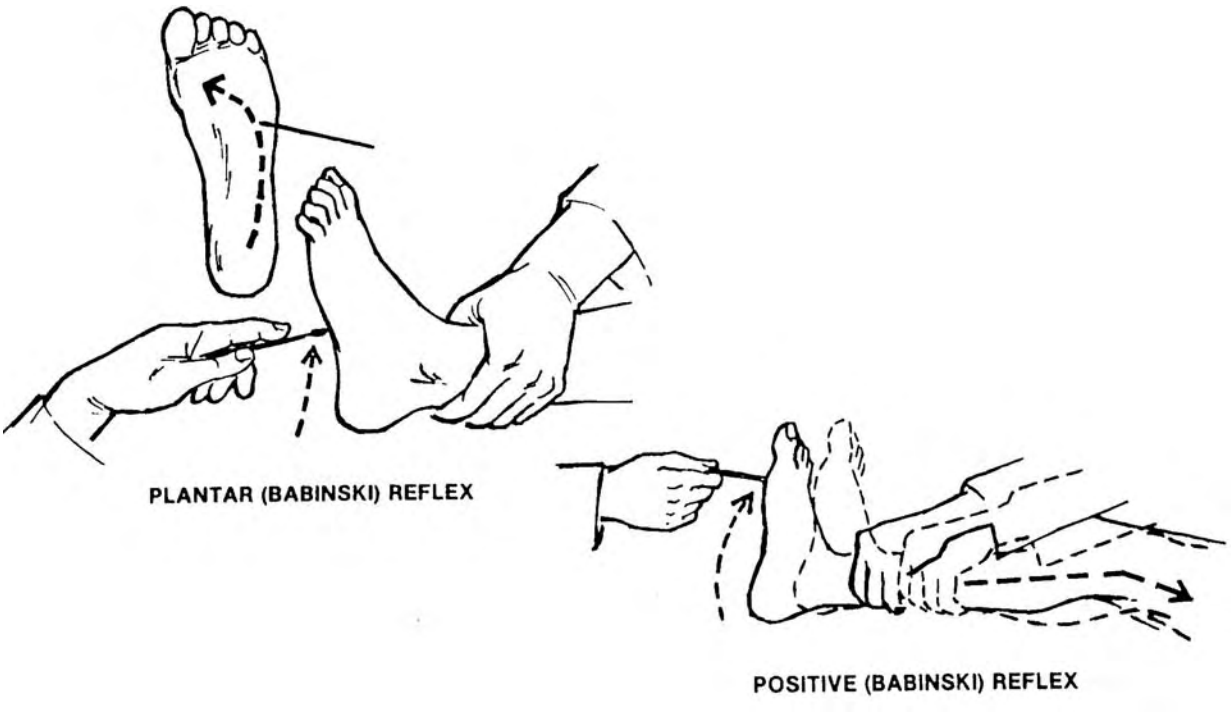

Figure 2-10. Checking the plantar reflex.

(d) Patellar reflex (knee jerk). Test the reflex in this manner:

1 Have the patient sit on a table or high bed to allow his legs to swing freely.

2 Tap the patellar tendon directly with a rubber hammer.

3 Normally, the knee extends.

NOTE: If muscle centers in the second, third, or fourth lumbar segments of the spinal cord are damaged, the reflex may be blocked. People with chronic diabetes or neurosyphilis may not have that reflex.

4 Conduct the reflex check as shown in figure 2-12 if the patient must be lying down. Put your hand under the popliteal fossa and lift the patient's knee from the table or bed. Tap the patellar tendon directly.

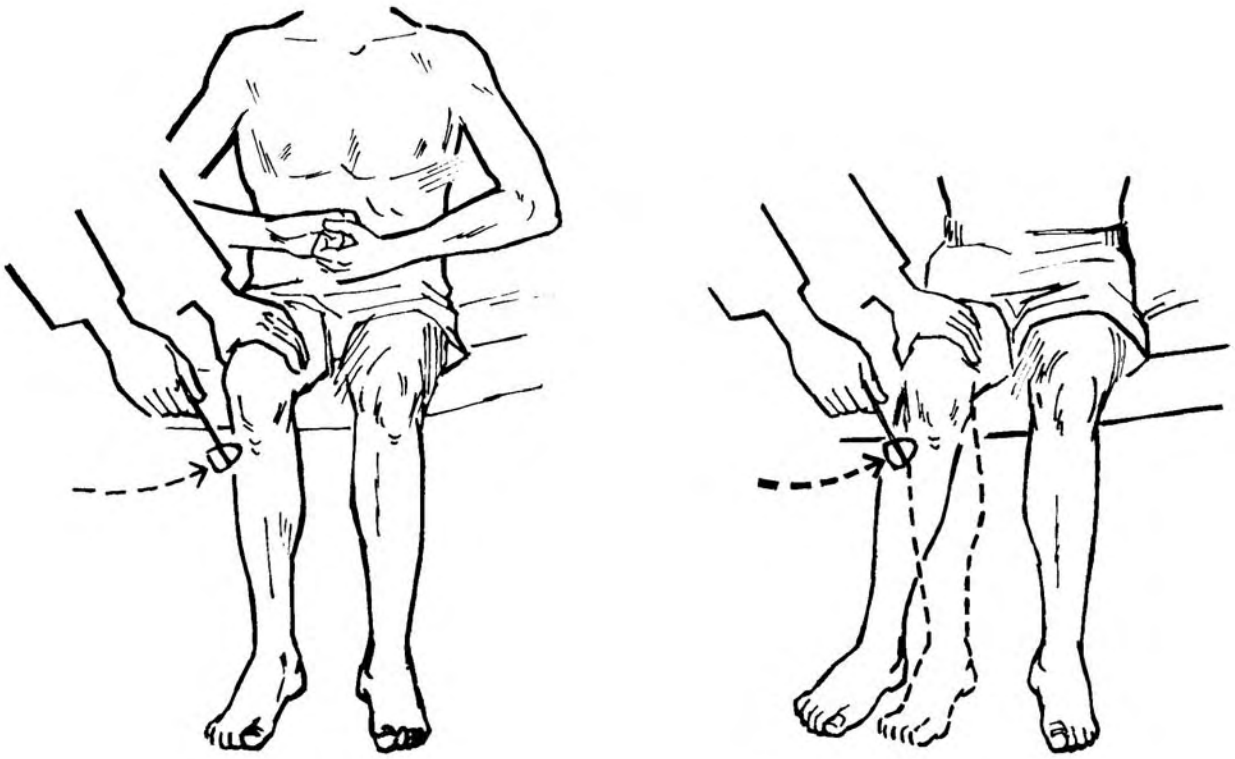

Figure 2-11. Patellar reflex (knee jerk).

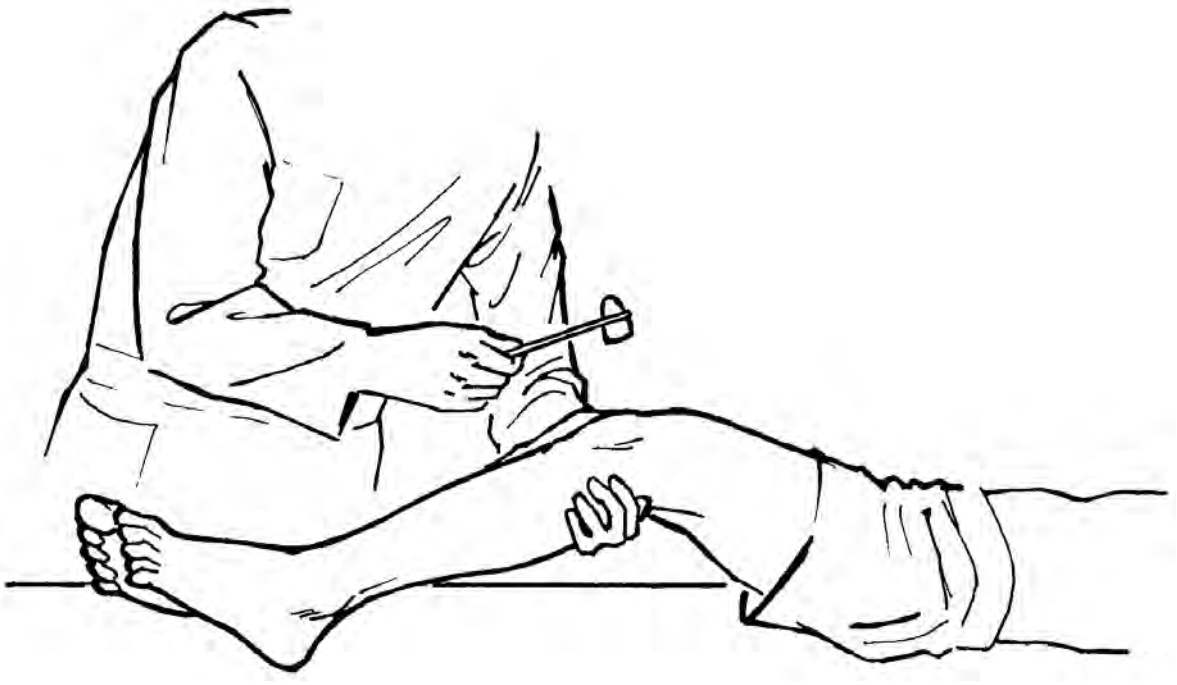

Figure 2-12. Patellar reflex (knee jerk) from a supine position.

(e) Achilles reflex (ankle jerk). Tap the Achilles tendon and the foot should extend from the contraction of the gastrocnemius and soleus muscles responding to that tap. Perform the reflex test in this manner:

1 Have the patient sit on a table or bed so that his legs dangle.

2 With your left hand, grasp the patient's foot and pull it in dorsiflexion (upward). Find the degree of stretching upward of the Achilles tendon that produces the optimal response.

3 Tap the tendon directly.

4 Normal response is contraction of the gastrocnemius and plantar flexion of the foot.

NOTE: If the normal response does not occur, there may be damage to the nerves supplying the posterior leg muscles or damage to the nerve cells in the lumbosacral region of the spinal cord. Individuals who do not have this response (the ankle jerk) include persons with chronic diabetes, neurosyphilis, alcoholism, and subarachnoid hemorrhages.

Figure 2-13. Achilles reflex (ankle jerk).

5 If the patient must be in the supine position, perform the check in this manner. Partially flex the hip and knee, then rotate the knee outward as far as is comfortable for the patient. With your left hand, grasp his foot and pull the foot upward. Tap the Achilles tendon directly. The normal response is plantar flexion.

2-5. CLOSING STATEMENT

The stresses of modern society have created a great need for medics who can properly assess and treat nervous disorders. This is true both in the hospital setting and the combat zone. Performing a physical assessment of the nervous system is the first vital step in treating such disorders.

Continue with Exercises

EXERCISES, LESSON 2

INSTRUCTIONS. The following exercises are to be answered by writing the answer in the space provided. After you have completed all the exercises, turn to Solutions to Exercises at the end of the lesson and check your answers.

1. List four central nervous system malfunctions that can occur as a result of injury to the brain.

   a. _____.

   b. _____.

   c. _____.

   d. _____.

2. List three malfunctions that can occur as a result of injury to the spinal cord.

   a. _____.

   b. _____.

   c. _____.

3. Nerve paralysis is the result of injury in the _____nervous system.

4. You are conducting a generalized neurological examination. List three elements you should notice about the patient as he enters the room.

   a. _____.

   b. _____.

   c. _____.

5. The words alert, lethargic, stupor, semicoma, and coma are used to describe a person's _____.

6. A patient who is sleepy or drowsy but can be awakened and will respond to a command is in the level of consciousness termed _____.

7. The part of the brain which controls the skeletal muscles and coordinates voluntary muscular movement is the _____.

8. In the _____ test, the patient is instructed to stand with his feet together and arms at his side, first with his eyes closed and then with his eyes open. Expect him to sway a little, but if he really loses his balance, he may have a neurologic problem.

9. Asking a patient to grip your hands and squeeze is part of a test for _____ which is a motor function.

10. Testing muscle reflexes helps determine how responsive the_____ is.

11. At least four groups of people with specific health problems do not have the Achilles reflex. These four groups are persons with:

    a. _____.

    b. _____.

    c. _____.

    d. _____.

12. A reflex is _____

13. An examiner strokes the patient's skin with a hard object such as an applicator stick. What reflex is begin tested?

    _____

14. Lightly stimulating the outer margin of the sole of the foot is a test of the Babinski or _____ reflex.

15. Touching the skin with a cotton ball and asking the patient to tell you the area you have touched is part of a neurological test for _____ function.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 2

1. You are correct if you listed any four of the following:

   Interference in nerve impulses.
   Impairment of autonomic functions.
   Impairment of thinking processes.
   Impairment of seeing, hearing, and speaking. (para 2-2a)

2. Impairment of the spinal cord reflex.
   Impairment of touch.
   Impairment of movement. (para 2-2a)

3. Peripheral. (para 2-2b)

4. You are correct if you listed any three of the following:

   Posture and motor behavior.
   Dress, grooming, and personal hygiene.
   Facial expression.
   Speech.
   Manner, mood, and relation to persons and things around him.
   (paras 2-3a through e)

5. Level of consciousness. (paras 2-4a(1)(a) through (e))

6. Lethargic. (para 2-4a(1)(b))

7. Cerebellum. (para 2-4b)

8. Romberg. (para 2-4b(4))

9. Muscle strength. (para 2-4c(3)(a))

10. Spinal cord. (para 2-4f(3))

11. Chronic diabetes.
    Neurosyphilis.
    Alcoholism.
    Subarachnoid hemorrhages. (para 2-4f(4)(e); NOTE)

12. An immediate and involuntary response to a stimulus. (para 2-4f)

13. The superficial reflex. (para 2-4f(2))

14. Plantar. (para 2-4f(4)(c))

15. Sensory. (para 2-4e(2))

End of Lesson 2

LESSON ASSIGNMENT

LESSON 3	Central Nervous System Diseases and Disorders.
LESSON ASSIGNMENT	Paragraphs 3-1 through 3-11.
LESSON OBJECTIVES	After completing this lesson, you should be able to:

3-1. Define and identify the cause, signs/symptoms, and treatment for meningitis.

3-2. Define and identify the cause, signs/symptoms, and treatment for encephalitis.

3-3. Define and identify the cause, signs/symptoms, and treatment for poliomyelitis.

3-4. Define and identify the cause, signs/symptoms, and treatment for Parkinsonism (Parkinson's disease).

3-5. Define and identify the cause, signs/symptoms, and treatment for amyotrophic lateral sclerosis.

3-6. Define and identify the cause, signs/symptoms, and treatment for muscular sclerosis.

3-7. Define disorders affecting the levels of consciousness and identify the causes, signs/symptoms, and treatment for these disorders.

3-8. Define specific vascular disorders of the central nervous system and identify the causes, signs/symptoms, and treatment for these disorders.

SUGGESTION After completing the assignment, complete the exercises of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 3

CENTRAL NERVOUS SYSTEM DISEASES AND DISORDERS

Section I. DISEASES OF THE CENTRAL NERVOUS SYSTEM

3-1. INTRODUCTION

Most diseases of the central nervous system (CNS) are disabling or life-threatening. Your prompt recognition of the signs and symptoms of these diseases will help the patient get prompt treatment and make recovery easier and faster. Many of these conditions can affect a person of any age.

3-2. MENINGITIS

a. **Definition of Meningitis.** This CNS disease is an acute inflammation of the meninges of the brain or the spinal cord. All three meningeal membranes--the dura mater, the arachnoid, and the pia mater--may be affected.

b. **Cause of Meningitis.** The inflammation may be caused by any one of the following: pyrogenic bacteria, mycobacteria, fungi, spirochetes, or viruses. Sometimes an upper respiratory infection (URI) is the primary cause of the illness.

c. **Sign/Symptoms of Meningitis.** Signs and symptoms are similar to those of an upper respiratory infection. Included are the following:

(1) Headache.

(2) Back pain.

(3) Stiff neck.

(4) Chills.

(5) Irregular fever.

(6) Anorexia (loss of appetite).

(7) Confusion.

(8) Drowsiness.

(9) Stupor.

(10) Coma may develop as the illness progresses.

(11) Brudzinski's sign. The abrupt neck flexion in the supine patient causes involuntary flexion of the knees. When passive flexion of the lower limb on one side is made, a similar movement is seen in the opposite limb. Another name for Brudzinski's sign is contralateral sign.

d. **Treatment of Meningitis.** Treat the symptoms and perform necessary life-supporting measures. Usually, the patient is treated as follows:

(1) Usually, antibiotics are given intravenously for a period of time (often two weeks). Oral antibiotics are given after these medications. Appropriate oral antibiotics include penicillin, tetracycline, or erythromycin.

NOTE: If there is intracranial pressure (ICP), mannitol may be given. This medication should relieve pressure on the brain.

(2) Other medications which can be given include anticonvulsants if needed or a sedative to reduce restlessness. Aspirin or acetaminophen can be given to relieve headache and fever.

(3) Supportive measures include bed rest, lowering of body temperature, and measures to prevent dehydration.

(4) If the patient's nasal cultures are positive, isolate him.

(5) Treat any other conditions such as endocarditis or pneumonia.

3-3. ENCEPHALITIS

a. **Definition of Encephalitis.** This disease is defined as an inflammation of the brain due to a direct invasion by a virus. Lymphocytes (a white blood cell which has formed in lymphoid tissue) filter into the brain tissues and the leptomeninges (pia mater and arachnoid) and cause cerebral edema, degeneration of the brain's ganglion cells, and nerve cell destruction. Between World War I and the Depression, a type of encephalitis called lethargic encephalitis occurred from an unknown cause. The disease is rare today, but the term "sleeping sickness" still exists. You may find people who refer to all types of encephalitis by this term today.

b. **Cause of Encephalitis.** Encephalitis is caused by arthropod-borne viruses in rural areas. In cities, encephalitis can occur after mumps, influenza, chicken pox, or measles.

c. **Signs/Symptoms of Encephalitis.** There are some differences, but the several forms of encephalitis have similar signs and symptoms. The onset of the disease is usually sudden. Signs and symptoms include the following:

(1) Headaches.

(2) Fever.

(3) Lethargy or restlessness.

(4) Cranial nerve abnormality.

The signs and symptoms are similar to those of viral meningitis, but in this case are not bacterial. The patient has fewer chills, and his glucose level is normal.

d. **Treatment of Encephalitis.** Generally, give supportive treatment. That is, treat the symptoms of the disease.

3-4. POLIOMYELITIS (INFANTILE PARALYSIS)

a. **Definition of Poliomyelitis.** This central nervous system disease is defined as an inflammation of the gray matter of the spinal cord. The severity of this communicable disease ranges from an almost unnoticed infection to fatal paralytic illness.

b. **Cause of Poliomyelitis.** The cause of this highly contagious disease is viral. Three distinct types of polio viruses are found worldwide. These viruses are spread from person to person by direct contact with infected oropharyngeal secretions or feces. These viruses attack the anterior horn of the spinal cord and the brain stem. In the 1940s and 50s, poliomyelitis attacked children and young adults most often. Today, the disease usually affects groups of people who have not been immunized.

c. **Signs/Symptoms of Poliomyelitis.** Signs and symptoms of the disease are restricted to either the spinal segment or the gray matter of the medulla oblongata of the brain. As such, they are called spinal or bulbar, respectively. The spinal form of the disease is most severe in one extremity, usually the lower extremity. The diaphragm and the intercostal muscles may be involved. The bulbar form of the disease commonly affects the respiratory muscles and requires prompt intensive care.

d. **Treatment of Poliomyelitis.** Treat the symptoms. Analgesics may be given to ease headache, back pain, and leg spasms. Morphine is NOT given because it suppresses the respiratory system, a system which the disease may slow down. Moist heat may be applied to reduce muscle spasms and pain.

e. **Preventive Measures for Poliomyelitis.** Preventive treatment is done by means of the Salk vaccine or the Sabin vaccine. The Salk vaccine consists of the killed virus while the Sabin vaccine uses attenuated (weakened) live viruses.

3-5. PARKINSONISM (PARKINSON'S DISEASE)

a. **Definition of Parkinsonism.** This is a chronic, progressive degenerative disease of the nervous system. The disease progresses for a number of years after which the person succumbs to an illness such as aspiration pneumonia or some other infection. Today, this disease is a common crippling disease in the United States and affects more men than women.

b. **Cause of Parkinsonism.** The disease affects the balance coordinating the extrapyramidal tract which is located at the idiopathic basal ganglia. Possible causes include atherosclerosis (a form of arteriosclerosis), head trauma, carbon dioxide or metal poisoning, a large dose of tranquilizers, or brain tumors which cause midbrain compression.

c. **Signs/Symptoms of Parkinsonism.** The signs and symptoms of this disease begin slowly. The basic symptoms are muscle rigidity, akinesia or dyskinesia (slowness of automatic movements), and a tremor that begins in the fingers. This tremor increases with stress or anxiety and decreases when the patient moves deliberately and after sleep. Other signs and symptoms include the following:

(1) Impaired locomotion with stiffness, dragging of one foot, and shuffling gait.

(2) Stiff, mask-like facial appearance.

(3) Impaired autonomic function such as constipation, incontinence, and excessive perspiration.

(4) Emotional strain resulting in mood swings. Examples include fear of being seen in public and quarrelsomeness with family.

d. **Treatment for Parkinsonism.** Treatment is aimed at relieving the patient's symptoms and keeping him functional for as long as possible. It is very important to prevent muscular rigidity. Treatment should include measures to improve the patient's general health and mild tranquilizers to reduce tremor. Synthetic medications which can be used include levodopa (L-dopa) and Symmetrel^{R}.

3-6. AMYOTROPHIC LATERAL SCLEROSIS (ALS) (Lou Gehrig's disease)

a. **Definition of ALS.** This disease is the most common of the motor neuron diseases that cause muscular atrophy (muscle degeneration and loss of function). Motor neurons in the spinal cord, medulla, and cortex degenerate.

b. **Causes of ALS.** The cause of the disease is not known specifically. What is known is that the disease produces muscular atrophy through degeneration of the motor cells in the spinal cord and the medulla. The disease usually occurs in the 50 to 70 age group.

c. **Signs/Symptoms of ALS.** The disease is characterized by progressive muscular weakness. Aching pain and emotional outbursts are also signs and symptoms of ALS.

d. **Treatment of ALS.** Presently, no effective treatment for ALS exists. The aims of managing the disease are to provide emotional, psychological, and physical support and to control the patient's symptoms.

3-7. MULTIPLE SCLEROSIS (MS)

a. **Definition of Multiple Sclerosis.** This is a chronic, progressive disease characterized by demyelination (destruction or loss of myelin from the sheath of a nerve) of the white matter of the brain and the spinal cord. (Myelin is a fatty substance that is a major part of the sheath that protects the axon of some nerve cells.)

b. **Cause of Multiple Sclerosis.** There are theories about what causes MS, but the exact cause of the disease is not known. The disease is more prevalent in cool climates. Young adults between 20 and 40 years of age are more affected by MS than people in other age groups.

c. **Signs/Symptoms of Multiple Sclerosis.** Signs and symptoms do not have a predictable pattern. They may last for hours or weeks, or come and go. The disease is characterized by remission and then weakness of the extremities, incontinence, and Charcot's triad. Signs and symptoms of Charcot's triad include nystagmus (involuntary movement of the eyes), tremor, or scanning speech. Other signs and symptoms of MS include the following:

(1) Ataxia (failure or irregularity of muscular coordination).

(2) Impaired pain and temperature sensation.

(3) Elevated gamma globulin in the cerebrospinal fluid.

d. **Treatment for Multiple Sclerosis.** There is no specific therapy for this disease. Steroids, however, offer temporary benefit. Treatment for the condition requires symptomatic general care.

Section II. DISORDERS OF THE CENTRAL NERVOUS SYSTEM

3-8. INTRODUCTION

The nervous system innervates and controls all the actions of the human body. This is the reason why a disorder of the nervous system may affect motor functions, disrupt bodily homeostasis, or balances.

3-9. DISORDERS OF CONSCIOUSNESS

a. **Definition of Disorders of Consciousness.** These disorders, either intracranial or extracranial, have a common cause which is loss of consciousness.

b. **Causes of Disorders of Consciousness.** An intracranial (inside the skull) disorder of consciousness can be caused by a tumor (compression of the upper brainstem, a stroke, seizure, intracranial pressure (ICP), or by metabolic changes such as hypoglycemia or toxic ketoacidosis. An extracranial disorder may be caused by trauma, electrical shock, drugs, and gases.

c. **Signs/Symptoms of Disorders of Consciousness.** These signs and symptoms could be a change in the patient's level of consciousness. In this case, the patient is alert and oriented. However, the patient could be lethargic, that is, sleepy or drowsy but able to be awakened and respond appropriately to a command. The patient could be in a stupor or spontaneous unconsciousness when it would be difficult to awaken him. The patient could be in a semicoma in which pain would arouse him. A patient in a coma cannot be aroused, even with painful stimuli. Changes in the level of consciousness are a primary diagnostic symptom which can be assessed and monitored. An initial baseline evaluation of the patient's level of consciousness is a necessity. Other signs and symptoms of disorders of consciousness include the following:

(1) Trauma to the head. Automobile accidents, motorcycle accidents, and falls from ladders, rooftops, etc., can cause such trauma.

(2) Abnormalities in the rate, depth, and odor of respirations.

(3) Changes in the pupils of the eye, responsiveness to light, diameter of the pupil, and speech reaction.

(4) Changes in the corneal reflex.

(5) Seizures. In this case, check respirations and prevent aspiration.

(6) Fluctuation of rectal temperatures due to hypothalamus malfunctions.

d. **Treatment of Disorders of Consciousness.** The main goal in treatment is to maintain life until diagnosis can be determined. Treatment consists of maintaining the patient's airway, breathing, and circulation (the ABCs). Spinal injury is always suspected in cases of disorders of consciousness. Immobilize the patient accordingly so that he does not further injure himself. Maintain an IV until the patient's intracranial status can be determined. Treatment of consciousness disorders should include a baseline physical examination to include checking the baseline level of consciousness (LOC) of the patient. Check his level of consciousness by asking him if he lost consciousness at any time, how long he has been oriented since then, and if he feels he is experiencing any personality changes. Another part of the rapid baseline physical examination is an evaluation of vital signs. This evaluation should include:

(1) Rechecking vital signs every 15 minutes.

(2) Checking temperature fluctuations. Fluctuations in temperature may indicate a malfunction of the hypothalamus.

(3) Checking the pulse. Bradycardia would indicate increased cranial pressure (ICP).

(4) Checking respirations. Check for Cheyne-Stokes, central neurogenic pattern, and hypoventilation. Initially, an increase in the depth of respirations with no significant change in rate of respirations may be seen. Later the rate of respirations may increase, but eventually respiratory depression occurs.

(5) Checking blood pressure. An increase in blood pressure may indicate increased, intracranial pressure. Try to assess for evidence of trauma and intoxication. Do this by inspecting the head and neck for injury. If trauma is suspected, use a clinical collar.

(6) Establish baseline vital signs, pupil size, corneal reflex, and check for the presence of movements, reflexes, and paralysis of the extremities.

3-10. COMMON NERVOUS SYSTEM DISORDERS

a. **Vascular Headaches.**

(1) Migraine headache. The exact cause of migraine headaches is unknown. An individual may have inherited a tendency for migraine headaches. Other possible causes include emotional stress, hypersensitivity, and the body's vascular mechanism of dilation of extracranial and intracranial arteries.

(a) Signs/symptoms of migraine headaches. Included are the following:

1 Paroxysmal (sudden onset) of headache, often preceded by psychologic or visual disturbances. The headache may be unilateral (on one side of the head) or bilateral (on both sides of the head).

2 Dizziness.

3 Commonly, sharp pains in the frontal region of the head, especially at the temple.

4 Excessive sweating, nausea, and vomiting.

5 Hypersensitivity to light and sound.

(b) Treatment of migraine headaches. It is important to take medication early on in a migraine headache attack. Ergotamine tartrate (Gynergen) is the drug of choice for this condition. Ergotamine tartrate stimulates the smooth muscle of the blood vessels to constrict. The dosage is 2 mg orally or 0.25 mg intramuscularly or subcutaneously. CAUTION: This medication can build up in the patient's body causing ergotism. (Ergotism is poisoning from excessive use of medicinal ergot.) Signs and symptoms of ergotism include numbness/tingling of fingers or toes, muscle pain and/or weakness, gangrene, and blindness. Another ergotamine preparation is ergotamine and caffeine (Cafergot). Ergotamine, phenobarbitol, and belladone (Cafergot P-B) are effective therapy for migraine headache complication by tension and gastrointestinal upset. A general aid for a migraine headache is to have the patient sit or lie down in a darkened, quiet room for one to two hours. The darkened room is used because of the sensitivity to light experienced by a patient with a migraine headache.

(2) Cluster headache (Morton's syndrome). The cause of this disorder is similar to that of a migraine headache. The exact cause of a cluster headache is unknown. Sensitivity to histamines may be a cause of this type of headache.

(a) Signs/symptoms of a cluster headache. Included are the following:

1 Severe and frequent attacks of short duration, usually in "cluster or group." The headaches may occur daily or several times a day for several weeks. The headache problem may resolve itself for a few months, then recur.

2 The headache may occur at the same time of day and on the same side of the head behind one eye.

3 Pain is accompanied by a tugging, pulling, or pressing sensation behind one eye.

4 Noticeable signs include nasal congestion, excessive tearing of the eye, and possibly one "bloodshot" eye.

5 Length of time of the headache may be from a few minutes to hours but usually not more than two hours. The average duration of such a headache is 30 to 90 minutes.

(b) Treatment of a cluster headache. Treat with ergotamine tartrate (Gynergen). Ergotamine tartrate will relieve a cluster headache quickest if given by intramuscular injection (may cause vomiting) or administered sublingually. Oral medications which are available act too slowly to be of much help. Usually, this type of headache lasts such a short time that medication does not have time to be effective.

(3) Hypertensive headache. Increased blood pressure causes a hypertensive headache.

(a) Signs/symptoms of a hypertensive headache. Included are the following:

1 Throbbing.

2 Sudden onset, frequently at the top of the head but may also be generalized in the head.

3 Elevated blood pressure and retinal hemorrhages.

(b) Treatment of a hypertensive headache. Lower the blood pressure by giving a combination of analgesic (pain killer medication) and tranquilizer. Try to find out the cause of the raised blood pressure.

(4) Muscle tension headache. Tension and emotional stress cause this type of headache. What happens is that the muscles in the neck and the scalp contract causing pain.

(a) Signs/symptoms of muscle tension headache. Such a headache is usually characterized by steady pain which is non- throbbing. The pain may be on one or both sides of the head but is often in the frontal region of the face.

(b) Treatment of muscle tension headache. Treatment consists of mild analgesic, rest, and removal of the situation which produced the anxiety.

b. **Vascular Disorders.** Vascular disorders include stroke, cerebrovascular accidents (CVA), and cerebral apoplexy. Vascular disorders of the central nervous system are defined as a sudden loss of brain function or a disruption of blood flow to the brain. This loss or disruption may result in impairment in motor, sensory, or mental functions.

(1) Causes of vascular disorders. Included are the following:

(a) Thrombosis--formation or presence of a blood clot.

(b) Embolism--sudden obstruction of a blood vessel caused by the movement of a blood clot or other plug (for example, air).

(c) Hemorrhage--bleeding, especially profuse.

(d) Compression--pressing together of a blood vessel by an external force.

(e) Vasospasm--spasm or contraction of a blood vessel.

(2) Signs/symptoms of vascular disorders. The dysfunction may be major or minor, and may be temporary or permanent. Here are some early warning signs:

(a) Sudden, temporary weakness or numbness of the face, arm, and leg.

(b) Temporary difficulty with speech (aphasia).

(c) Brief dimness or loss of vision, especially in one eye.

(d) Double vision (diplopia).

(e) Brief dizziness or unsteadiness.

(f) Loss of memory.

(g) Change in personality or change in mental ability.

(3) Motor disability signs of vascular disorders.

(a) Hemiplegia--paralysis of the entire side of the body opposite to the injured side of the head.

(b) Hemiplesis--partial paralysis; muscle weakness.

(c) Paraplegia--paralysis of either both upper extremities or, more commonly, both lower extremities.

(d) Quadriplegia--upper and lower extremities are paralysized.

(e) Monoplegia--localized paralysis, a condition sometimes seen in trauma patients.

(4) Treatments for vascular disorders. Treatments may be short term or long term.

(a) Short-term treatment consists of treating the specific symptoms caused by CVA, maintaining the airway, and taking frequent vital signs.

(b) Long-term treatment includes the prevention of further loss of function with physical therapy and patient participation in a comprehensive rehabilitation program.

3-11. CLOSING STATEMENT

You have now learned how to identify and treat various nervous system disorders successfully. These knowledges are of utmost importance in your service as a medical NCO.

Continue with Exercises

EXERCISES, LESSON 3

INSTRUCTIONS. The following exercises are to be answered by writing the answer in the space provided. After you have completed all the exercises, turn to Solutions to Exercises at the end of the lesson and check your answers.

1. An acute inflammation of the meninges of the brain or the spinal cord is the definition of _____.

2. List four signs or symptoms of meningitis.

   a. _____.

   b. _____.

   c. _____.

   d. _____.

3. Encephalitis is defined as _____

   _____

4. How is encephalitis treated? _____

   _____

5. Poliomyelitis is _____

   _____.

6. List the two types of vaccine used to prevent poliomyelitis.

   a. _____.

   b. _____.

7. Parkinsonism or Parkinson's disease is a _____

_____

8. A stiff, mask-like facial appearance is characteristic of _____

_____

9. Motor neurons in the spinal cord, medulla, and cortex degenerate in the disease, _____ also known as Lou Gehrig's disease.

10. _____ is a chronic, progressive disease characterized by demyelination of the white matter of the brain and the spinal cord.

11. _____ is the term for failure or irregularity of muscular coordination.

12. Trauma, electrical shock, drugs, and gases can cause _____cranial disorder.

13. List three signs/symptoms of migraine headaches.

    a. _____.

    b. _____

    c. _____.

14. Throbbing head, sudden onset of pain, and retinal hemorrhages are signs/symptoms of a _____ headache.

15. List two causes of muscle tension headache.

    a. _____.

    b. _____.

16. Vascular disorders of the central nervous system are _____

_____

17. Hemiparesis, a motor disability sign of a vascular disorder, is characterized by _____ paralysis and _____ weakness.

18. Three signs/symptoms of vascular disorders are:

    a. _____.

    b. _____.

    c. _____.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 3

1. Meningitis. (para 3-2a)

2. You are correct if you listed any four of the following:

Headache.	Confusion.
Back pain.	Drowsiness.
Stiff neck.	Stupor.
Chills.	Coma.
Irregular fever.	Brudzinski's sign.
Loss of appetite.	(paras 3-2c(1) through (11))

3. An inflammation of the brain due to a direct attack by a virus. (para 3-3a)

4. Treat the symptoms of the disease. (para 3-3d)

5. An inflammation of the gray matter of the spinal cord. (para 3-4a)

6. Salk vaccine.
   Sabin vaccine. (para 3-4e)

7. A chronic, progressive degenerative disease of the nervous system. (para 3-5a)

8. Parkinsonism or Parkinson's disease. (para 3-5c)

9. Amyotrophic lateral sclerosis (ALS). (para 3-6a)

10. Multiple sclerosis (MS). (para 3-7a)

11. Ataxia. (para 3-7c(1))

12. Extra. (para 3-9b)

13. You are correct if you listed any three of the following:

    Sudden onset of pain.
    Dizziness.
    Sharp pain in the frontal region of head, especially the temples.
    Excessive sweating, nausea, vomiting.
    Hypersensitivity to light and sound. (paras 3-10a(1)(a)1 through 5)

14. Hypertensive. (paras 3-10a(3)(a)1 through 3)

15. Tension.
Emotional stress. (para 3-10a(4))

16. A sudden loss of brain function or a disruption of blood flow to the brain.
(para 3-10b)

17. Partial.
Muscle. (para 3-10b(3)(b))

18. You are correct if you listed any three of the following:

Sudden weakness/numbness of the face, arm, leg.
Aphasia.
Vision problem, especially in one eye.
Diplopia.
Brief dizziness/unsteadiness.
Loss of memory.
Personality change.
Mental ability change. (paras 3-10b(2)(a) through (g))

End of Lesson 3

LESSON ASSIGNMENT

LESSON 4	Seizures.
LESSON ASSIGNMENT	Paragraphs 4-1 through 4-5.
LESSON OBJECTIVES	After completing this lesson, you should be able to:
	4-1. Identify the causes of seizures and epilepsy.
	4-2. Identify the classification and signs/symptoms of epileptic seizures.
	4-3. Identify the treatment of seizure disorders.
SUGGESTION	After completing the assignment, complete the exercises of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 4

SEIZURES

4-1. INTRODUCTION

Help! Come quick! You, the 91W20, are the first person to arrive on the scene. You see an individual on the floor twitching and jerking uncontrollably. Would you know what to do? Would you know how to keep the patient from injuring himself? These questions and more will be answered in this lesson.

4-2. CAUSES OF SEIZURES AND EPILEPSY

Epilepsy is one of the most common and yet puzzling disorders of the central nervous system. Epilepsy is a condition of the brain characterized by sudden, brief attacks of altered consciousness, motor activity, sensory phenomena, or inappropriate behavior. The term seizure refers to a convulsion or an attack of epilepsy. About half the cases of epilepsy result from unknown causes. Possible causes of the other half of the epilepsy cases include the following:

a. **Disorder of the Brain.** An underlying disorder of the brain which could be structural, chemical, physiological, or a combination of all three.

b. **Genetic Association Indicated by Family History.** A study can be made of other family members to see how many have had epilepsy and/or seizures.

c. **Congenital Abnormalities.** Rubella during pregnancy causes multiple, congenital malformations in infants.

d. **Perinatal Factors.** Birth trauma and asphyxia neonatorum are important causes of brain damage leading to epilepsy.

e. **Infectious Diseases.** Convulsions may accompany any acute infection of the nervous system. An inflammatory process causing brain damage may cause convulsions.

f. **Toxic Factors.** Lead poisoning, alcohol, and drugs can cause seizures. Lead poisoning is most dangerous in children aged one to three years. The chronic alcoholic is liable to have seizures, and drugs such as amphetamines can cause seizures.

g. **Trauma and Physical Agents.** Cerebral injuries, anoxia (cardiac arrest or near drowning), and hyperthermia (secondary to excessive environmental temperatures and dehydration).

h. **Circulatory Disturbances.** Vascular disorders that interfere with cerebral circulation causing neuronal anoxia will cause a seizure. Examples of such vascular disorder include hemorrhage, embolus, or thrombosis.

i. **Neoplasms.** These are new and abnormal formations of tissue such as a tumor or growth.

4-3. CLASSIFICATION OF EPILEPTIC SEIZURES

Types of epileptic seizures you are most likely to encounter include the following:

a. **Petit Mal Seizures.** The tendency to this type of seizure is usually inherited. The classic petit mal seizure (also called absence seizure) is characterized by three phases: a sudden vacant expression or stare; stopping any motor activity (akinetic seizure); and myoclonic jerks (contraction and relaxation of muscles) with or without loss of muscle tone. These seizures are very brief (lasting from one to three seconds), and the individual may have as many as 100 of these seizures a day. These seizures are so brief that often the person looks like he is daydreaming or staring. His eyelids may flutter rapidly. Immediately after his attack, the individually returns to his normal activity. The episode is so brief that often neither the patient nor those around him notice anything unusual. The seizure may occur with or without loss of muscle tone. The person's eyes may rotate upward briefly, and he may blink his eyes. His head may droop but rarely fall. Fingers and hands may contract and relax. Usually, he is not incontinent. Petit mal seizures occur mainly in children from three to ten years of age. Such seizures almost never occur in anyone over age 20. If such a seizure does occur, it indicates the presence of organic brain disease. A child with this type of seizure may have grand mal epilepsy as he grows older.

b. **Focal Seizures.** These seizures are also called Jacksonian seizures, simple seizures, and partial seizures. Motor, sensory, or autonomic functions may be affected. The part or parts of the body affected indicate the particular place in the cerebrum where a lesion is located, the lesion causing the seizure. The seizures are localized or on only one side of the body. The person's head and eyes may turn to one side. Jerking limbs will be on only one side of the body. If the seizure progresses to a generalized convulsion, the person may become unconscious, and the attack may develop into a full grand mal seizure.

c. **Grand Mal Seizures.** This type of seizure (also called generalized seizure, major seizure, and tonic-clonic seizure) usually lasts two to three minutes but may last as long as ten to fifteen minutes. A person may suffer a grand mal seizure and a petit mal seizure at the same time. There are four phases to a grand mal seizure: the prodromal phase, the tonic phase, the clonic phase, and the postictal phase.

(1) Prodromal phase. In this phase, 50 percent of the patients experience an aura, that is a particular sensation described as an odd or unpleasant sensation rising from the stomach toward the chest and throat; that is a kind of premonition before the seizure occurs. The individual cries out (a respiratory muscle has a spasm) and loses consciousness, falling to the ground. NOTE: Some patients experience the same aura before each seizure. The aura may cause numbness or motor activity such as turning the head and eyes or the spasm of a limb. The aura may be a peculiar sound or baste or a memory from the past.

(2) Tonic phase. This phase is characterized by continuous body tension. There is a sustained contraction of all muscles in the body; the body is rigid with fixed jaws, hands clenched, and legs extended. The person's face may be red or cyanotic due to a spasm of the respiratory muscle. His pupils are dilated, corneal and deep tendon reflexes are absent, and the Babinski sign is positive.

(3) Clonic phase. The person's muscles alternately contract and then relax rapidly. The phase follows the tonic phase in less than a minute. The individual's jerky movements are caused by the alternating contractions and relaxation of his muscles (myoclonic jerking of arms and legs and/or the body trunk). Frothing at the mouth, loss of bladder and bowel control, tongue biting, bruises, and contusions commonly occur during this phase.

(4) Postictal phase. The clonic convulsive phase gradually subsides. The fourth phase characterized by a deep sleep with gradual recovery. When the person awakens, he may be confused, tired, have muscle soreness, and a headache. Encourage him to rest because activity could bring about another attack.

d. **Status Epilepticus.** Status epilepticus is a medical emergency and is a series of seizures that occur in rapid succession with no intervening periods of consciousness. A grand mal status epilepticus may persist for hours or days resulting in a coma. The coma may be fatal due to hyperthermia (very high body temperature) and exhaustion. If any seizure lasts over ten minutes, the seizure is considered status epilepticus and, therefore, a medical emergency. The cause of status epilepticus is often the result of improper drug therapy for epilepsy. This condition can also occur spontaneously.

e. **Psychomotor Seizures.** These are seizures that do not adhere to the classic criteria of the grand mal, focal, or petit mal seizures. Characteristics of psychomotor seizures include the following:

(1) The individual loses contact with his environment for one to two minutes.

(2) He does not fall, but he may stagger around performing automatic purposeless movements. Also, he may utter unintelligible sounds, turn his head or eyes, smack his lips, rub his hair, or rub his face.

(3) He does not understand what is said, and he resists help.

(4) He is mentally confused for another one to two minutes after the seizure seems to be over.

(5) Following the seizure, the individual usually does not remember what he did during the attack.

(6) Psychomotor seizures may develop at any age and are usually associated with structural lesions of the temporal lobe of the brain.

f. **Hysterical Attacks.** This condition may resemble grand mal epilepsy. Characteristics of the attack include the following:

(1) The attack begins slower, and the person's movements are purposeful.

(2) He experiences no tongue biting or incontinence.

(3) He remains conscious.

(4) If and when he falls, he does not usually injure himself.

(5) He may resist help, and the "convulsion" may be erratic and atypical (unusual and not typical of seizures).

(6) The patient usually has a history of emotional upset and neurosis.

4-4. TREATMENT OF SEIZURE DISORDERS

a. **General Principles.** Included are the following:

(1) Encourage the person to lead a normal life with social activities.

(2) Recommend moderate exercise with proper safeguards; for example, swimming and horseback riding.

(3) Automobile driving after one year has passed since the last seizure.

(4) No alcoholic beverages.

(5) The individual's family should use their common sense and guard against overprotecting him and being overly sympathetic. The family should suggest that the person enter vocational rehabilitation and join a local interest group such as the Epilepsy Foundation of America. They should encourage the person to take his medication regularly and to carry an identification card stating that he is an epileptic.

b. **Initial Aid to a Seizure Patient.** Although seizures are rarely life-threatening, good management techniques can help the patient. Follow these guidelines:

(1) Prevent the person from injuring himself. To keep him from biting his tongue or the inside of his mouth, place a tongue depressor, handkerchief, or padded gag between his teeth.

CAUTION: DO NOT cram anything in the person's mouth, and be careful with your fingers.

(2) DO NOT restrain the person.

(3) DO NOT leave him alone.

(4) Loosen his clothing, especially clothing around his neck, and place a pillow under his head.

(5) Turn his head to the side after the seizure activity. This will allow mucus to flow out of his mouth.

(6) DO NOT give him drugs during the attack except for treatment of status epilepticus. Drugs could delay the completion of the attack.

(7) Be careful not to overreact or overtreat the person.

(8) If necessary, arrange for the person to be hospitalized.

c. **Recording and Reporting Seizures.** Follow this procedure:

(1) Record personal observations of the patient. Be accurate in your description of details.

(2) Record circumstances preceding the attack. Record what the patient told you and what he did. Also, record statements of what he did from witnesses.

(3) Record exact sequence of seizure symptoms. Be sure to include:

(a) Where on the body did the seizure start?

(b) Was the seizure local or generalized?

(c) How long did the seizure last? Include the total time and the time of each phase of the seizure.

(d) List symptoms that were noticed during the seizure; for example, incontinence, cyanosis, pupil changes, etc.

(4) Laboratory findings. An electroencephalogram (EEG) is the most important test in the study of epilepsy. Drugs, photic stimulation, sleep, and hyperventilation may be of diagnostic value. Include skull x-rays, CSF studies, GTTs, CT scan of the head, cerebral angiograms, and brain stems.

(5) Drug therapy principles. No single drug is effective for all types of seizures. The person may require several drugs. Begin treatment with the smallest effective dose and increase the dosage until the seizures are controlled or until the person experiences side effects from the drugs. Monitor the person's blood level of anticonvulsants. For some reason, children often need and tolerate much larger doses of medication than their age and weight would indicate. Never withdraw anticonvulsant drugs suddenly. Continue medications for at least five seizure-free years. Alcoholics experiencing seizures are not helped by anticonvulsant drugs or are of little value.

(6) Medications for specific types of seizures.

(a) Grand mal-focal--psychomotor seizures. The drug of choice for control of frequent seizures is Dilantin^{R} (phenytoin sodium). Watch for side effects. Possible side effects include gum hypertrophy, nervousness, rash, ataxia, drowsiness, and nystagmus (involuntary rapid movements of the eyeball). When this medication is given intravenously, monitor the person's blood pressure every five minutes. Another drug which can be given is phenobarbital.

(b) Status epilepticus. Give one of the following drugs slowly:

1 Valium^{R} (diazepam).

2 Dilantin^{R} (phenytoin sodium).

3 Phenobarbital sodium.

4 Amytal^{R} (amobarbital sodium).

5 Intractable cases may require general anesthesia.

4-5. CLOSING STATEMENT

Remember, when you arrive on the scene of an individual having a seizure, your quick thinking and management of the situation may very well make all the difference in the recovery of the patient. Your report on the circumstances of the incident will aid the doctor in his diagnosis and result in quicker treatment for the patient.

Continue with Exercises

EXERCISES, LESSON 4

INSTRUCTIONS. The following exercises are to be answered by writing the answer in the space provided. After you have completed all the exercises, turn to Solutions to Exercises at the end of the lesson and check your answers.

1. Epilepsy is _____

   _____

2. What does the term seizure refer to? Seizure refers to: _____

   _____

3. List three toxic substances that can cause seizures.

   a. _____.

   b. _____.

   c. _____.

4. Neoplasms, a cause of epilepsy, are _____

   _____.

5. List the characteristic three phases of the classic petit mal seizure.

   a. _____.

   b. _____.

   c. _____.

6. Seizures which are localized, affecting only one side of the body are called Jacksonian seizures. Other names for these seizures are simple seizures, partial seizures, and _____ seizures.

7. List the four phases of the grand mal seizure.

   a. _____.

   b. _____.

   c. _____.

   d. _____.

8. The phase of the grand mal seizure in which the muscles of the body are very tense is the _____ phase.

9. A series of epileptic seizures which occur in rapid succession with no intervening periods of consciousness is a medical emergency and is called _____ _____.

10. In a _____ seizure, the individual may lose contact with his environment for only one or two minutes and usually does not remember what he did during the seizure.

11. A _____ attack resembles grand mal epileptic attack with some exceptions including these: the person remains conscious, he experiences no tongue biting, and he does not injure himself when he falls.

12. List four things you would NOT do when giving initial aid to a seizure patient.

    a. _____

    b. _____.

    c. _____.

    d. _____.

13. The most important test in the study of epilepsy is _____.

14. A seizure patient should continue taking his medications for _____ after the last seizure.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 4

1. A chronic, neurologic disease marked by sudden loss of consciousness and frequently by convulsions. (para 4-2)

2. Seizure refers to a convulsion or an attack of epilepsy. (para 4-2)

3. Lead.
   Alcohol.
   Drugs. (para 4-2f)

4. New and abnormal formations of tissue such as a tumor or growth. (para 4-2i)

5. Sudden vacant expression or stare.
   Stopping of motor activity.
   Loss of muscle tone. (para 4-3a)

6. Focal. (para 4-3b)

7. Prodromal phase.
   Tonic phase.
   Clonic phase.
   Postictal phase. (paras 4-3c(1) through (4))

8. Tonic. (para 4-3c(2))

9. Grand mal status epilepticus. (para 4-3d)

10. Psychomotor. (para 4-3e)

11. Hysterical. (para 4-3f)

12. DO NOT cram anything in the person's mouth.
    DO NOT restrain the person.
    DO NOT leave him alone.
    DO NOT give him drugs. (paras 4-4b(1) through (8))

13. An electroencephalogram (EEG). (para 4-4c(4))

14. 5 years. (para 4-4c(5))

End of Lesson 4

LESSON ASSIGNMENT

LESSON 5 Central Nervous System Trauma.

LESSON ASSIGNMENT Paragraphs 5-1--5-27.

LESSON OBJECTIVES After completing this lesson, you should be able to:

5-1. Identify pathophysiological factors of head injuries which cause or worsen head injuries.

5-2. Identify events that occur as intracranial pressure rises.

5-3. Identify signs/symptoms and management techniques for these types of head injuries:

Scalp wounds.
Skull injuries.
Concussion.
Cerebral contusion.
Intracranial hematoma.

5-4. Identify the steps/procedures for examining/evaluating a patient with head trauma.

5-5. Identify the steps/procedures for treating patients with head injury.

5-6. Identify the pathophysiological factors relating to spinal cord injury.

5-7. Identify spinal cord injuries possibly caused by an accident.

5-8. Identify the possible mechanism of injury for a patient with a spinal cord injury.

5-9. Identify the events in an accident or evaluation of a patient that would require the patient to be treated as a spinal cord injury patient.

5-10. Identify the areas that should be assessed to fully evaluate a trauma patient.

5-11. Identify the treatment for a patient with a spinal cord injury.

5-12. A patient with a spinal cord injury is going into secondary shock. Identify the signs/symptoms of secondary shock.

5-13. Identify the indications for using an extrication device.

5-14. Identify common errors in management of a patient with central nervous system trauma.

5-15. Identify the steps/procedures for immobilizing a patient with central nervous system trauma.

SUGGESTION

After completing the assignment, complete the exercises of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 5

CENTRAL NERVOUS SYSTEM TRAUMA

Section I. HEAD INJURY

5-1. INTRODUCTION

Few nonfatal injuries cause such devastating physical and psychological effects as trauma to the central nervous system. In many cases, irreversible damage occurs regardless of the care the victim receives. In a significant number of cases, however, the initial care administered determines the ultimate outcome of the case. In fact, in such "treatable" patients, the emergency management is frequently more important than all subsequent efforts. This statement should trigger in your mind the importance of your role in the evaluation and initial care of these patients.

5-2. GENERAL INFORMATION

a. The most important initial indicator of the severity of a head injury is the patient's level of consciousness. A competent observer should assess the patient's consciousness level as soon as possible after the injury has occurred. A severe head injury may be defined as one that leaves the patient unconscious for at least 6 hours. A patient who has an altered level of consciousness less severe and for a shorter time period may have medical problems much later, problems caused by the injury.) Therefore, a patient with any level of impaired consciousness after a head injury should be treated as though he has a serious head injury.

b. The majority of head injuries are mild and self-limiting. However, since severe head injuries can be life-threatening, it is important to assess and treat a head injury correctly to prevent death or disability from secondary brain damage.

5-3. PATHOPHYSIOLOGY

Pathophysiology is the physiology of disordered function. When there is trauma to the central nervous system in the form of a head injury, a variety of pathophysiological responses can occur.

a. **Head Injury.** The words "head injury" usually refer to an injury to the portion of the skull (cranium) that encloses the brain, the overlying scalp, or the contents of the cranial cavity (brain, cranial nerves, meninges, and associated blood vessels). This definition focuses attention on that portion of the head that is at or above the level of the eyebrows anteriorly, the zygomatic arches laterally, and an imaginary line between the tips of the mastoid processes posteriorly. These are approximate external landmarks for the skull base, which is the floor of the cranial cavity. Nevertheless, physical signs of

injury of the brain or of its soft tissue or bony coverings may also be detected in adjacent structures of the head (eyes, ears, and nose) or even in portions of the body that are remote from it.

b. **Brain Injuries.** Most brain injuries occur due to movement of the brain inside the skull. The level of damage to the brain depends on the speed the head was traveling and the head's position just prior to contact.

c. **Responses to Brain Injury.** The base of the skull is rough; therefore, movement over this area will cause various degrees of injury to the brain or blood vessels. Possible responses to brain injury include the following:

(1) Initial response to a bruised brain is swelling. The swelling is caused by:

(a) Increased blood volume due to vasodilation and increased cerebral blood flow to the injured areas.

(b) Buildup of extra blood volume putting pressure on the brain and decreasing blood flow to the injured part.

NOTE: Since the edema builds over a period of 24 to 48 hours, early care and efforts to decrease the vasodilation is important.

(2) Carbon dioxide may build up, having a critical effect on cerebral vessels. This buildup causes more vasodilation.

(3) Hyperventilation may occur, causing a decrease in the carbon dioxide, vasoconstriction, and better perfusion (passage of a fluid through the vessels of an organ) for the brain.

NOTE: Hyperventilation -- a condition marked by fast, deep breathing, which tends to remove increased amounts of carbon dioxide from the body and lower the partial pressure of the gas, causing buzzing in the ears, and tingling of the lips and fingers.

(4) Unconsciousness may occur due to injury to the cerebral cortex or the brain stem.

(5) If there is increased intracranial pressure (ICP) and decreasing cerebral blood flow, no matter what the cause, the level of consciousness is depressed.

(6) The intracranial cavity is filled to capacity with contents that cannot be compressed -- cerebral spinal fluid, intravascular blood, brain tissue water (interstitial fluid). If the volume of one of the constituents of the intracranial cavity increases, a reciprocal decrease in volume of one or both of the others must occur. Otherwise, the result is an increase in intracranial pressure.

5-4. INTRACRANIAL PRESSURE (ICP)

a. **Changes Caused by Intracranial Pressure.** A patient with head injury may experience an alteration in his level of consciousness. Other symptoms associated with a severe head injury may include convulsions, delirium, coma, paralysis, and increased intracranial pressure, which will be discussed here. The skull (a container that cannot expand) holds the brain, vascular tissue, and cerebrospinal fluid. Any problem (trauma, edema, tumor, infection, or bleeding) which adds to the contents of the skull will result in an increase in intracranial pressure in the skull. That increased pressure sets off the changes listed below:

(1) As the intracranial pressure increases, the blood vessels are squeezed from the outside, restricting blood flow throughout the arteries.

(2) As the brain notes a drop in blood pressure, the sympathetic defenses respond, causing the blood pressure to increase.

(3) Respiratory changes occur due to the chemoreceptors that sense changes in the blood chemistry.

(4) The vagus nerve is affected, causing the pulse to slow.

(5) Cushing's response - Increased blood pressure characterized by slow pulse. This is a clear but late sign of increased intracranial pressure.

(6) As the intracranial pressure progresses, the level of consciousness is altered. Eventually, unconsciousness occurs because the body's vital functions cannot operate properly. Ultimately, there is brain death due to loss of adequate cerebral perfusion (passage of fluid through the brain).

(7) Once the brain's ability to compensate is exhausted, the areas of the brain shift, causing herniation.

NOTE: Compression may be from above (central syndrome) or from the side (lateral syndrome). The central syndrome progresses in a more orderly manner and causes unconsciousness early.

b. **Progressive Levels of Intracranial Pressure.** Three progressive levels of intracranial pressure can be identified.

(1) Progressive level one.

(a) Involves cerebral cortex and upper brain stem.

(b) Blood pressure rises, pulse slows.

(c) Pupils appear small but are reactive.

(d) Abnormal respiratory pattern noted (possibly Cheyne-Stokes).

(e) Initially, patient will try to remove painful stimuli. Later, the patient withdraws from pain.

(f) As progression occurs, the pain will cause decorticate posturing (flexion of the upper extremities with lower extremities becoming rigid and extended).

(g) Still reversible.

(2) Progressive level two.

(a) Middle portion of the brain stem is involved.

(b) Blood pressure increases.

(c) Pulse slows.

(d) Pupils become fixed at 3 to 5 mm and nonreactive or only sluggishly reactive to light.

(e) Abnormal respiratory pattern: fast, shallow panting (neurogenic hyperventilation).

(3) Progressive level three.

(a) Pupils become fixed and dilated.

(b) If only one "blown" pupil, it will be on the same side as the hematoma or swelling. (Crossover of nerves occurs at about the lip level.)

(c) Document which pupil dilates first.

(d) Respiratory ataxia (erratic, no rhythm) or absent.

(e) No response to painful stimuli.

(f) Pulse is rapid and irregular.

(g) Decreased blood pressure.

5-5. ANOXIC BRAIN INJURY

Anoxic brain injury is injury to the brain from lack of oxygen (from cardiac arrest, choking, or drowning). Spasms develop in small arteries if the brain goes without oxygen for more than 4 to 6 minutes. Blood flow does not reach the cerebral cortex. The level of brain damage is based on the length of anoxia (lack of oxygen).

5-6. SPECIFIC TYPES OF HEAD INJURY

a. **Scalp Wounds.** The scalp has many blood vessels, a number of which are close to the surface. A scalp laceration, therefore, may bleed profusely even though a major blood vessel has not been cut. Initially, even a minor laceration may bleed a great deal. Normally, blood in the scalp clots rapidly, and blood flow can be controlled easily. If necessary, bleeding can usually be controlled by direct pressure; that is, by compressing the scalp between the fingertips and the skull. It is important to control bleeding in both adults and children, but it is especially important in children because they have a smaller volume of blood.

b. **Skull Injuries.** The skull is composed of the cranium and the face. Skull fractures are commonly fractures to the cranium rather than the face.

(1) Signs/symptoms of skull injuries. The most obvious signs of a skull fracture are visible bone fragments and bits of brain tissue. The possibility of a skull fracture exists when any of the following less obvious signs/symptoms are present:

(a) Following an injury, the patient may be either unconscious or have an altered level of consciousness.

(b) The patient has sustained an injury that has caused a deep laceration or severe bruises to the scalp or forehead.

(c) There is severe pain or swelling at the site of a patient's head injury.

(d) There is a deformity of the patient's skull; for example, a depression in the cranium, a large swelling, or anything that looks unusual about the cranium's shape.

(e) The patient has a bruise or swelling behind the ear (Battle's sign - discoloration behind the ear caused by a fracture in the base of the skull). This sign may appear hours to days after the injury.

(f) The pupils of the patient's eyes are unequal in size.

(g) Tissue around or under both eyes of the patient are discolored ("black eye(s)" or "raccoon eyes"). This discoloration may appear hours after the injury.

(h) One of the patient's eyes appears to be sunken.

(i) The patient has bleeding from the ears and/or the nose.

(j) Clear fluid is flowing from the patient's ears and/or nose.

(2) Treatment for skull fracture.

(a) Follow these general procedures:

1 Assure/maintain an open airway.

2 Resuscitate, if necessary.

3 Keep the patient at rest; do not let him move around.

4 Control bleeding.

5 Monitor the patient's vital signs.

6 Dress and bandage any open wounds.

7 Try to keep a conscious patient alert by talking to him. Ask him questions to force him to concentrate.

(b) Remember:

1 DO NOT put pressure on an obvious skull fracture.

2 DO NOT try to remove penetrating objects. Leave them in place and transport the patient.

(c) If the patient has no hematoma, infection, or cerebral spinal fluid leak, a skull fracture presents no danger at this time.

c. **Concussion.** A concussion is a mild state of stupor or temporary unconsciousness caused by a blow to the head. In this condition, there is no laceration or bleeding in the brain. There is no significant injury to the brain itself.

(1) Signs/symptoms of concussion. Signs and symptoms of a concussion occur immediately. Included are the following:

(a) Knowledge that the patient has received a blow to the head, has had a temporary loss of consciousness, and memory loss are indications of a concussion.

(b) The most important indication of concussion is memory loss for the exact moment of injury. This is a sign of brain dysfunction. The patient may never remember the exact moment of injury. His brain had not had time to record the moment in his memory. Sometimes, the patient cannot remember events just preceding the moment of injury, a condition called retrograde. Or, a patient may not be able to remember events that happened just after the moment of injury, this condition being called antigrade. Short time memory loss may cause a patient to ask questions repeatedly about the moments surrounding his injury.

(c) The patient may become combative.

(d) Not all patients who have a concussion lose consciousness. But those who do may regain consciousness anywhere from a few minutes to an hour. If the loss of consciousness was only momentary, often neither the patient nor witnesses are sure whether or not the patient lost consciousness.

(2) Treatment for concussion. There is no specific treatment for a concussion. If the patient is not being detained for observation, a responsible adult should be told to check on the patient hourly. The adult should be told the signs/symptoms that would indicate that the patient needs further medical help. Usually, within 24 to 48 hours, the symptoms of concussion begin to subside.

d. **Cerebral Contusion.** A focal brain injury is an injury in which there is dysfunction of a particular region, system, or side of the brain. The most common type of focal brain injury is a cerebral contusion. This type of contusion is a bruise in the brain that consists of a superficial focus of brain hemorrhage, necrosis, and/or laceration.

(1) Types of cerebral contusions. Included are the following:

(a) Coup contusion. This type of contusion occurs in the part of the brain that is directly under the focus of an impact.

(b) Contrecoup contusion. This contusion occurs in areas of the brain that are remote from the focus of impact.

1 Blows to the back of the head commonly cause this type of contusion. A contrecoup contusion can, however, be caused by a blow to any part of the head.

2 There is scientific disagreement on exactly how a contrecoup contusion occurs. One theory is that the impact of something on the skull accelerates or decelerates the brain within the cranial cavity. The result is that the brain collides with the inner surface of the skull and becomes bruised.

(2) Treatment. Patients with cerebral contusion require hospitalization for observation.

e. **Intracranial Hematoma.** Intracranial hematoma (within the cranium, a swelling that contains blood) is a rare injury, but important because this injury is the most common cause of preventable death following a head injury. Two classifications of traumatic intracranial hematomas are acute epidural hematomas and acute subdural hematomas.

(1) Acute epidural hematoma. This type of hematoma is an accumulation of blood between the dura (the thick, dense, fibrous layer which covers and protects the brain and the spinal cord) and the inner surface of the skull. The cause of an acute epidural hematoma is either a tear in a meningeal artery within the dura or an impact injury to a dural venous sinus. Since the bleeding is arterial, pressure builds rapidly and death can occur quickly. But, the prognosis for recovery is good if the patient is diagnosed correctly and treated early. Signs and symptoms of acute epidural hematoma include the following:

(a) A history of head trauma.

(b) Initial loss of consciousness.

(c) Next, a period of consciousness and coherence.

(d) Patient lapses back into unconsciousness.

(e) Patient develops paralysis on the opposite side of the injury with dilated/fixed pupils of the eye on the same side as the injury.

(f) If not treated, paralysis is followed by death.

NOTE: The time when the patient is lucid and relatively alert is the period between the recovery from the primary brain injury (usually a concussion) and the onset of signs/symptoms of brain distortion/displacement by the hematoma. When you know that a person has had a blow to the head and you see this lucid period between periods of unconsciousness, suspect the presence of an acute epidural hematoma.

(2) Acute subdural hematoma. An acute subdural hematoma is caused by a high velocity impact. This type of hematoma comes from venous bleeding located between the dura and the brain. The impact damages the underlying brain tissue. Signs/symptoms include:

(a) Headache.

(b) Fluctuation in the level of consciousness.

(c) Semiparesis (muscular weakness/ mild paralysis on one side of the body).

NOTE: If surgery is performed less than 4 hours after the injury, the recovery rate for a patient with intracranial hematoma is about 90 percent. If surgery is performed more than 4 hours after the injury, the recovery rate is about 30 percent. Even a patient with acute intracranial hematoma has a better chance of recovery with early operative treatment.

GENERAL NOTE: Generally, patients with head trauma injury should be hyperventilated to get as much oxygen to the cells as possible and to lower intracranial pressure (pressure within the skull).

5-7. GENERAL ASSESSMENT OF HEAD TRAUMA

Approximately 40 percent of serious trauma victims have central nervous system injuries. This group has a death rate twice as high (35 percent versus 17 percent) as that of victims without central nervous system injuries. Estimations are that head injuries account for 25 percent of all trauma deaths and up to one-half of all motor vehicle fatalities. The head-injured victim will rarely be cooperative and is often under the influence of alcohol. When evaluating a patient with a head injury, always assume that the patient also has a spinal cord injury.

a. **Respiration.** A head injury produces several types of abnormal respiratory patterns. Possible abnormalities include:

(1) A slowed respiratory rate caused by an acute rise in intracranial pressure.

(2) A rapid respiratory rate can be caused if the intracranial pressure continues to rise.

(3) Respirations may be noisy.

(4) Kussmaul and Cheyne-Stokes patterns are often caused by the metabolic causes of coma.

b. **Blood Pressure.** Over a period of time, note any changes in the patient's blood pressure. The rise or fall of blood pressure can indicate changes in the patient's condition or further injury.

(1) Rising blood pressure. Generally, blood pressure rises if intracranial pressure rises. The systolic blood pressure in particular will rise. The effect is a widening of pulse pressure (pulse pressure = systolic blood pressure minus diastolic blood pressure). Therefore, if the patient's blood pressure rises without any medical explanation, he may experience a rise in intracranial pressure.

(2) Falling blood pressure. If the patient's blood pressure is falling, he may have an injury which has not been discovered and treated. The skull is a very small box which is almost full of brain. Therefore, there is very little room in the skull for blood. If the patient is in hypovolemic shock (shock produced by reduction of blood volume, possible cause is hemorrhage), he is probably bleeding somewhere other than the head. Look for a source of major hemorrhage somewhere else in the body.

c. **Pulse.** A change in pulse rate (either increasing or decreasing) may indicate a serious problem. Note the following conditions:

(1) A slowing pulse will usually accompany the rise in blood pressure observed in a patient with rising intracranial pressure. A continued rise in intracranial pressure can produce tachycardia (abnormally fast heart beat), causing death.

(2) A rising pulse rate may signal impending shock from bleeding elsewhere in the body.

(3) A rapid pulse without another cause is a serious sign.

(4) Bradycardia (an abnormally slow heartbeat) with hypertension suggests a rapidly expanding hematoma.

d. **General Examination.** A general examination should include the following:

(1) Check the scalp or skull for lacerations or fractures.

(2) Fluid from the ears and nose should be checked for the presence of spinal fluid. Soak up a small amount of drainage from the ears or nose with a 4 x 4 gauze square. Cerebral spinal fluid will form a ring around the blood.

(3) Any trauma above the clavicle (collarbone) should suggest cervical spine injury.

(4) Consider that the patient may have cervical spine injury and immobilize his head and neck if:

(a) The mechanism of injury suggests violent action to the spine.

(b) The patient has a severe head injury.

(c) Injury to the patient resulted in:

1 Loss of consciousness.

2 Markedly altered level of consciousness.

3 Display of specific signs of neurological deficit (motor or sensory).

e. **Special Considerations.** Be aware that:

(1) Drugs and alcohol will frequently change the level of consciousness and cloud significant signs and symptoms of the trauma patient.

(2) Altered respiratory patterns may be caused by other injuries and by uncorrected hypovolemia (markedly diminished blood volume).

(3) Metabolic abnormalities can alter respiratory function.

(4) Blood pressure elevation may be caused by pain, anxiety, or preexisting hypertension.

(5) Only at the terminal stages of head injury does the patient exhibit hypotension as the result of head injury itself.

(6) Assume a patient with low blood pressure is hemorrhaging elsewhere and treat for shock.

(7) Repeat examinations at intervals and record accurately. Look for trends and changes such as:

(a) Significant rise in blood pressure.

(b) Slower pulse occurring late in the cycle.

f. **Neurological Examination.** A neurological examination is performed to assess the patient's condition at the time he is being examined.

(1) AVPU for initial assessment. The letters AVPU stand for methods of assessing a patient's responsiveness or unresponsiveness. The patient will be checked for alertness, verbal responsiveness, pain responsiveness, and, finally, unresponsiveness.

(a) Alertness to stimuli.

(b) Responds to verbal stimulus.

(c) Responds to painful stimulus.

(d) Unresponsive to stimuli.

(2) Glasgow coma scale for secondary assessment. Patient responses in these areas are checked:

(a) Eye opening.

(b) Verbal response.

(c) Motor response.

(3) Evaluation of pupils for equality/reaction to light. Check the patient's eyes for normal or abnormal reactions as follows:

(a) Normal reactions include:

1 When exposed to light, the pupils constrict.

2 When light is shined into one pupil, the other pupil also constricts.

(b) Abnormal reactions include:

1 Pupils are fixed and pinpoint.

2 Drooping upper eyelid when eyes are open (ptosis).

3 One pupil dilated and fixed.

4 Both pupils dilated and fixed.

5-8. JUDGING LEVEL OF SEVERITY OF HEAD INJURY

The most important indication of the severity of a patient's head injury is the patient's level of consciousness. His initial level of consciousness is also the best indicator of how well the patient will recover from the head injury. A changed level of consciousness reflects the degree of generalized injury to the brain. Initially, the patient's level of consciousness can be assessed by testing his responses to stimuli using the AVPU test.

a. A - Is the patient alert? Is the patient looking around to find out where he is?

b. V - Does the patient respond to verbal stimuli? When asked a question, does the patient respond well or at all?

c. P - Does the patient respond to painful stimuli? Does the patient respond to a pinch or a pin prick?

d. U - Is the patient unresponsive? Does the patient respond to no stimuli at all?

5-9. LEVELS OF HEAD INJURY

a. **The Glasgow Coma Scale.** The Glasgow Coma Scale (GCS) is the most widely used system of defining the level of consciousness of head-injured patients. Older classification systems relied on descriptive terms such as obtundation (diminished pain or touch sensations), stupor, semicoma, etc. These terms sometimes meant different signs/symptoms to different people. The Glasgow Coma Scale defines the level of consciousness according to three functions: eye-opening, language function (verbal response), and movement (motor response).

b. **Responses of Glasgow Coma Scale.** Each of these functions has a set of subscales made up of a hierarchy of responses which are assigned numerical values (points). The patient is stimulated, his response is observed, and a point value is given based on the response. The person examining the patient tries to draw out the best response from the patient. The total number of points from these patient responses defines a level of consciousness (recognized worldwide) and indicates the severity of the head injury.

c. **Points Assigned Responses on the Glasgow Coma Scale.** The points assigned patient responses are as follows:

(1) Eye opening. Examiner determines the best eye response in accordance with the following response grading scale:

(a) Eyes open spontaneously -- 4 points.

(b) Eyes open in response to speech -- 3 points. The patient opens his eyes when he is told to do so, or he responds to a command.

(c) Eyes open in response to noxious stimuli -- 2 points.

(d) Eyes do not open in response to noxious stimuli -- 1 point.

(2) Verbal response. Examiner determines the best verbal response in accordance with the following response grading scale:

(a) The patient is oriented to person, place, and time -- 5 points. The patient can talk and say who he is, where he is, the year, and the month.

(b) The patient is not oriented (is confused), but is able to communicate -- 4 points. The patient can talk but is somewhat confused.

(c) The patient speaks in a disorganized manner (inappropriate speech) -- 3 points. The patient does not enter into conversations but says understandable words (a curse, for example) or may say words which do not make sense.

(d) The patient responds with moaning or groaning sounds (incomprehensible sounds) -- 2 points. The patient vocalizes (makes sounds) but does not say recognizable words.

(e) The patient has no verbal response -- 1 point. The patient does not vocalize. He makes no sounds, nor does he respond to noxious stimulus.

(3) Motor response. Examiner determines the best motor response in accordance with the following response grading scale.

(a) The patient obeys commands appropriately and is able to move all extremities equally and spontaneously -- 6 points.

(b) The patient is still able to obey commands, but exhibits weakness (for example, drifting of an upper extremity) -- 5 points.

(c) The patient attempts to withdraw from the source of painful stimulus (flexor withdrawal) -- 4 points.

(d) The patient flexes an extremity abnormally -- 3 points.

(e) The patient extends an extremity abnormally -- 2 points.

(f) The patient has no motor response to painful stimuli (flaccid) -- 1 point.

NOTE: The Glasgow Coma Scale may not be valid in certain circumstances. The score of a patient who has used alcohol or other mind-altering drugs, is hypoglycemic, is in shock (systemic blood pressure less than 80 mm Hg), or who is hypothermic (body temperature below 34^{o} C) may not accurately reflect the patient's level of consciousness.

d. **Meaning of Total Points on Glasgow Coma Scale.** The total points accumulated from the patient's responses indicate the following levels of consciousness:

EYE OPENING		Eye score
Spontaneous	= 4	
To sound	= 3	___
To pain	= 2	
None	= 1	
BEST VERBAL RESPONSE		Verbal score
Oriented	= 5	
Not oriented (confused)	= 4	___
Inappropriate speech	= 3	
Incomprehensible sounds	= 2	
None	= 1	
BEST MOTOR RESPONSE		Motor Score
Obeys commands	= 6	
Localizes stimulus	= 5	___
Withdrawal from stimulus	= 4	
Abnormal flexion	= 3	
Abnormal extension	= 2	
Flaccid	= 1	
Patient's consciousness level	TOTAL POINTS =	____

Figure 5-1. Glasgow Coma Scale. (Abbreviated response scale)

(1) Comatose. Less than 8 points on the Glasgow Coma Scale.

(2) Moderate head injury. GCS total of 9 to 12 points.

(3) Mild head injury. A total point count of 13 to 15 on the Glasgow Coma Scale.

5-10. GENERAL MANAGEMENT OF HEAD TRAUMA

Follow these general principles in managing patients with possible head trauma:

a. Focus on maintaining adequate oxygen and cerebral blood flow.

b. Hyperventilate (increased amount of air) to decrease the increased intracranial pressure and prevent brain stem herniation by causing vasoconstriction (narrowing of blood vessels).

c. Maintain an airway. This is critical since the injured brain has increased oxygen demands.

d. Prevent coughing, bucking, seizing since any of these will raise intracranial pressure.

e. Intubate early, if possible, since a head trauma patient will frequently aspirate (intake of foreign material into the lungs during the act of breathing).

f. Protect the cervical spine.

g. Prepare to suction. Patients with head injuries often vomit.

h. Control bleeding and reestablish circulation.

NOTE: If direct pressure is used to control scalp wounds, remember to press only on a stable skull.

i. Be alert for shock. Start an IV of lactated Ringer's solution to keep a vein open and adjust the rate to the patient's needs.

j. Be observant of possible internal injury. Shock without gross bleeding will not be caused by brain injury except at the terminal stage. The patient may have internal injuries.

k. Head injury with multiple trauma should be managed the same as any other patient in shock. Establish an IV with an electrolyte solution and use a pneumatic antishock garment such as MAST, if necessary and appropriate to control bleeding.

l. A patient with only a head injury should be fluid restricted to decrease cerebral edema.

m. Anticonvulsants may be required.

n. Document carefully. Describe the patient's condition in terms of responsiveness to the environment.

NOTE: Avoid words such as lethargic, semiconscious, obtunded (to diminish pain or to diminish touch sensation).

Section II. SPINAL CORD INJURY

5-11. GENERAL INFORMATION

a. Approximately 10,000 people suffer spinal cord injuries each year in the United States. Most of these injuries are caused by instability of the vertebral column following trauma. A spinal cord injury can be devastating to the patient in many ways.

b. The spinal cord has two major functions. First, it is a two-way conductor pathway between the brain stem and the peripheral nervous system. Second, the spinal cord is a reflex center for all spinal reflexes. A large number of messages to and from the brain are sent through the spinal cord -- the pathway function. In its reflex capacity, the spinal cord allows us to react quickly to such things as pain and too much heat without the time involved in the brain having to send orders.

c. Damage to the spinal cord may isolate a part of the body from the brain. The patient may have a complete injury, losing all conscious motor and sensory function below the injury. Or, he may have an incomplete injury, retaining some motor or sensory function. Many injuries to the spine result in ligament sprains or nondisplaced fractures. Such injuries heal well and have an excellent prognosis. Displaced fractures or dislocations of the spine can damage the spinal cord or the nerve roots resulting in permanent paralysis or death.

d. The healing power of spinal cord nerve tissue is limited. If spinal cord nerve tissue is damaged to a certain point, that nerve tissue will not heal. The patient will have a loss of function that cannot be restored.

e. The goal of initial care of a patient with a possible spinal cord injury is to keep further injury from occurring. Specifically, you want to prevent additional damage to the brain, the spinal cord, and the major nerves of the body. In many cases, the care first given to such a patient determines whether he regains normal function of his body or is crippled for the rest of his life.

5-12. PATHOPHYSIOLOGY

a. It should be assumed that any unconscious patient who is the victim of an accident may have a spinal injury. Detection of spinal injuries can be difficult. The patient may not have signs or symptoms of damage to the spinal cord immediately. It is often assumed that a person with spinal cord damage will be completely or partially paralyzed. This is not always the case. The patient's spinal cord may be damaged, but initially he may not have paralysis or paresis (partial paralysis, weakness).

NOTE: There is a difference between paralysis and paresis. Paralysis is loss of movement; paresis is weakness or incomplete loss of muscular power.

b. Be cautious in moving the patient. Incorrect movement may cause irreparable spine damage even if there are no signs or symptoms of spinal injury.

c. Do not rely on the fact that the patient does not exhibit the usual signs/symptoms of spinal cord injury. The patient's ability to move his extremities or the absence of numbness, tingling, and other signs of neurological damage only indicate the spinal cord is intact so far. This is NOT an indication that there is no injury to the spinal cord.

5-13. INJURY TO THE SPINAL CORD

A number of injuries to the spinal cord are possible as the direct result of an accident. The resulting dysfunction depends on the location of the spinal cord damage. Symptoms of spinal cord trauma can occur in body parts below the site at which injury to the spinal cord occurred.

a. **Types of Spinal Cord Damage as a Direct Result of an Accident.** Included are the following:

(1) Cutting of the spinal cord --complete or incomplete.

(2) Pinching of the spinal cord -- with or without vertebral displacement.

(3) Stretching of the spinal cord.

(4) Compression fractures of vertebrae in the spinal cord.

(5) Displacement of vertebrae -- small or complete.

(6) Bruise of the spinal cord.

(7) Overstretching and other damage to ligaments and muscles involved in the spinal cord.

b. **Spinal Cord Injury and Resulting Dysfunction.** Trauma to the spinal cord can affect all the body systems -- motor system, sensory system, and autonomic system. The part of the spinal cord damaged determines the resulting dysfunction. Look at the following:

(1) Cervical cord injuries. Injuries to the eight pairs of cervical nerves cause:

(a) Paralysis of all the extremities and the body trunk. Initially, the muscles become flaccid (soft), and later they become spastic.

(b) Bowel and bladder involvement and dysfunction.

(c) Respiratory failure.

(2) Thoracic cord injuries. Injuries to the 12 pairs of thoracic nerves cause:

(a) Paralysis of the lower extremities.

(b) Paralysis of the bladder and rectum.

(c) Pain to the chest or back.

(d) Abdominal distention.

(3) Lumbar cord injuries. Injuries to the five pairs of lumbar nerves cause:

(a) Paralysis of the lower extremities.

(b) Paralysis of the bladder and the rectum.

NOTE: Lumbar cord injuries cause the affected muscles to become flabby and limp. The severity of the lumbar cord injuries determines sensory perception and muscle group damage.

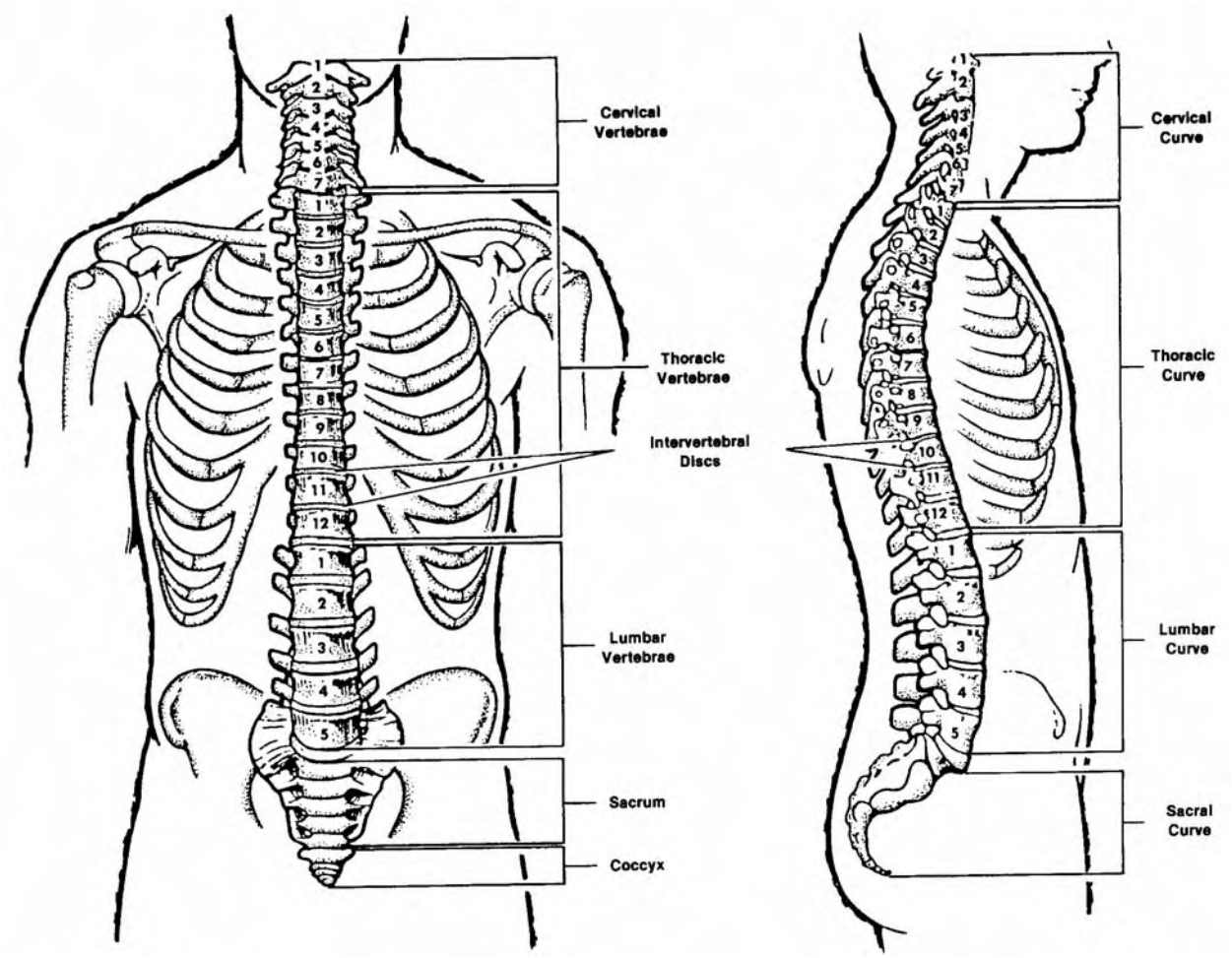

Figure 5-2. Front and side view of the vertebral column.

5-14. MECHANISM OF INJURY

Spinal cord injury can be caused by a number of mechanisms. Mechanisms of injury discussed here are divided into these four areas: axial loading; flexion, extension, and rotation; lateral bending; and distraction.

a. **Axial Loading.**

(1) Definition. Axial loading is a sudden, excessive compression which drives the weight of the body against the head. For example, a downward blow to the head such as a heavy object falling on the head can crush or fracture the vertebrae, which in turn can pinch or compress the spinal cord or nerve roots. An upward force to the feet as in a fall from a great height can have the same result.

(2) Injuries. In either of the instances mentioned in the previous paragraph, the sudden excessive compression drives the weight of the head and thorax against the lumbar spine while the sacral spine is driven upward. Driving injuries often cause axial loading injury.

b. **Flexion, Extension, Rotation.**

(1) Definition. Flexion is the act of bending or the condition of being bent. Extension is movement by which the two elements of any jointed part are drawn away from each other. Rotation is movement of the body about the body's axis. These spinal cord injuries occur when the spine moves past its normal range of motion.

(2) Injuries. Injuries caused include bone damage, tearing of muscles and ligaments, and tearing of the spinal cord.

(a) Flexion-rotation injuries. These injuries can occur at any level of the spinal cord. Usually, flexion-rotation injuries involve the cervical area, particularly C5 and C6. The cervical vertebrae can be dislocated by a sudden impact, the impact shearing supporting ligaments and blood vessels.

(b) Forced extension (hyperextension) injuries. In this injury, the head is sharply thrust back, and the upper spinal segments hyperextend (that is, these segments are extended beyond their normal limits). Such an accident can disrupt support ligaments, rupture intervertebral disks, and fracture one or more pedicles (vertebrae stem). The result is that the spinal cord is compressed and destabilized. An example is a person falling face down on stairs he is climbing up. The force to the head or chin thrusts the head back sharply, intervertebral disks rupture, vertebral bodies fracture, and supporting ligaments are damaged.

c. **Lateral Bending.**

(1) Definition. The head and neck are bent to one side, beyond normal limits.

(2) Injury. Lateral bending can cause significant injury to the cervical spine.

d. **Distraction.**

(1) Definition. Distraction is the pulling apart of the spine.

(2) Injury. This pulling apart stretches and tears the spinal cord. An example of distraction as a mechanism of injury is suicide by hanging. Gunshot wounds to the chest, back, and abdomen may also cause distraction type injury to the spinal cord.

CAUTION: It is wise to assume that any patient who is unconscious after trauma might have spinal cord injury. Also, assume that any patient with head trauma injury may have a spinal cord injury until you know otherwise.

5-15. MANDATORY TREATMENT FOR SPINAL INJURY

In some circumstances, it should be assumed that there is spinal injury, regardless of whether or not the patient has signs or symptoms of such an injury. Treating the patient as though he has injury to the spine may spare him further, nonreversible injury.

a. **Initial Indications.** Initial indications that the patient must be treated as if he has a spinal injury include the following:

(1) The mechanism of injury was violent. Witnesses' statements, the way the accident scene looks, and/or the situation indicate violence.

(2) The patient has a head injury and is in an altered state of consciousness.

(3) The patient is in a state of unconscious trauma.

(4) The patient has significant blunt trauma above the clavicles (collarbones).

(5) Accounts of the accident suggest that a sudden, violent movement, deceleration of the spine, or signs of spinal injury occurred.

(6) The patient was ejected from an automobile.

(7) The patient's helmet was damaged in a motorcycle or sports injury.

(8) The patient is experiencing pain when he moves and when he does not move.

(9) There is point tenderness surrounding the spine. (Point tenderness is tenderness at the site of injury. The patient feels the tenderness when a rescuer presses gently with one finger at the site of the injury.)

(10) There is a deformity in the patient's neck, or the patient guards (protects) his head, neck, or back.

(11) The patient is experiencing paralysis, partial paralysis, numbing, or tingling.

(12) There are signs of vasodilation (widening of the blood vessels allowing increased blood flow).

(13) The patient has a gunshot wound between the neck and the pelvis.

b. **Additional Clues.** Suspect spinal cord injury if the patient has any of the following:

(1) Extensive abrasions.

(2) Lacerations (wounds made by a tearing of the tissue) to the face/forehead (due to cervical hyperextension).

(3) Scalp lacerations (could be caused by compressions or fracture of the spine)

(4) Abrasions (superficial injury in which skin or mucous membrane is scraped away) of the back of the neck or upper thorax (due to flexion injury to the dorsal spine).

(5) Fractured mandible (jawbone) or associated contusion or abrasion about the jaw (associated with rotational injury to the spine).

(6) Calcaneal injury (heel bone), thoracic, and lumbar compression fracture.

(7) Abdominal bruises (lumbar fracture).

5-16. GENERAL ASSESSMENT

Make a quick but complete assessment at the scene of the accident. Do this to determine the extent of injury to the patient. Set up priorities for care because any life-threatening condition requires immediate care. As you observe the patient, find out the history of the accident.

a. **Mechanism of Injury.** Determine how the injury occurred. Ask the patient if he is conscious and alert. Ask witnesses and examine the accident site.

b. **Exact Time of Injury.** Try to determine the exact time the patient was injured.

c. **Sensations Felt by Patient.** Does the patient feel pain, weakness, numbness, paralysis, or tingling?

d. **Movement of Patient.** Has the patient been moved since the injury occurred?

e. **Patient's Signs/Symptoms.** Have the signs and symptoms experienced by the patient changed since the accident occurred? If so, how?

5-17. PHYSICAL ASSESSMENT

a. **Primary/Secondary Survey.** The primary survey and the secondary survey are actually done in a flowing motion. These two surveys are not really separated. The difference is that the primary survey is done quickly and in a short time while the secondary survey is done in more depth with touching and feeling the patient. During the primary survey, temporarily stabilize the patient's head and neck until the survey is complete. Remember, it is possible to cause permanent paralysis to the patient by moving him improperly if he has a spinal cord injury.

(1) Primary survey. Primary survey is a rapid examination to determine the patient's condition. The examination should not take more than one and a half to two minutes. The examination should consist of the following:

(a) Evaluate the airway, cervical spine control, and the patient's initial level of consciousness.

(b) Evaluate the patient's breathing.

(c) Evaluate the patient's circulation.

(d) Stop the patient's major bleeding.

(e) Observe the general appearance of the patient.

(f) Note the position in which the patient was found. Some positions are characteristic of certain injuries. For example, a patient with his arms in the "stick em up" position may have a cervical spinal injury. If the patient's arms are flexed across his chest and his hands are half closed, there may be damage to the 6th vertebra of the cervical spine.

(2) Secondary survey. The secondary survey does not begin until the primary survey has been completed. The secondary survey is a head-to-toe evaluation. This indepth evaluation utilizes the look, listen, and feel techniques, evaluating the body by sections.

(a) Hypotension (abnormally low blood pressure) minus shock. Be alert for signs/symptoms of hypotension without signs of shock. This condition indicates the patient is experiencing neurogenic shock (shock originating in the nervous system).

(b) Depth of breathing. Observe the depth of the patient's breathing as you count the patient's respirations. If the respirations are coming from the diaphragm only, assist in ventilations.

(c) Head/face cuts and/or bruises. Check the patient's head and face for cuts or bruises. Most patients with cervical spine injuries also have head or facial injuries.

(d) Neck abnormalities. Gently palpate the patient's neck for deformity and tenderness. If the patient is conscious, ask him to tell you if he feels any tenderness as you palpate.

(e) Chest/abdomen internal injuries. Examine the chest and abdomen of the patient for signs of internal injury. A patient whose skin is pale, cold, and clammy and who has tachycardia (abnormally fast heartbeat), may be in hypovolemic shock (abnormally decreased amount of blood and fluids in the body). Bleeding into the chest or abdomen are possible causes of such shock.

(f) Priapism (sustained erection). Observe for priapism. Priapism is a characteristic sign of spinal cord injury.

(g) Control of elimination. Note any signs of loss of bowel or bladder control.

(h) Spinal area check. Log roll the patient (turning the body as one unit, and check the spinal area for deformity or pain.

1 Examine the patient's back for any swelling or hematoma over the spinal area. Either of these signs would indicate the presence of a bony fracture.

2 Look for a spasm in paravertebral muscles. A curvature of the spine often indicates such spasms.

3 Look for any open injuries involving the spinal column. Cover any such injury with a sterile dressing.

b. **Neurologic Examination.** The purpose of a neurologic assessment is to furnish data about the exact condition of the patient when he was first seen. Later, any changes in the patient's condition may be evaluated, and the course of further treatment determined. The neurologic assessment is NOT to decide whether or not to immobilize the patient.

(1) Check the spinal nerve tracts for position, pain, and movement.

(2) Check for normal movement of toes and fingers. Does the patient feel normal sensation? Can the patient tell when some one is moving his (the patient's) finger or toes up or down?

(3) Does the patient feel pain in response to a pin prick? Start at the patient's feet and move upward. Mark the level at which the patient first feels the pin prick.

CAUTION: A normal neurologic examination does not rule out the possibility that the patient has a spinal cord injury. Persons who have been in accidents involving automobiles, motorcycles, trucks, etc. have walked away from the accident. Hours later the individuals have become totally paralyzed after a nod of the head which squeezed an unstable vertebral column down against the spinal cord. Therefore, when the mechanism of injury suggests that the patient could have a spinal cord injury, treat him as though he does have such an injury, regardless of the neurologic findings.

c. **Motor Function Check.**

(1) Can the patient wiggle his toes? Fingers? If not, can he move his wrists, elbows, etc.?

(2) If the patient is unconscious, test with a noxious stimulus and observe him for signs of withdrawal.

REMEMBER: Assessment is NOT to determine whether the patient should be immobilized, but to establish the patient's condition at the moment of assessment.

5-18. TREATMENT FOR SPINAL CORD INJURY

The goal of treatment for spinal cord injury is to support the patient's vital functions and prevent further damage. Remember that improper handling of a patient with a spinal injury can cause permanent paralysis. As with assessment, begin the treatment with the ABCs of airway, breathing, and circulation. Then, add the C of cervical spine stabilization and other elements of treatment.

a. **A - Airway.** Ensure that secretions are not blocking the airway. Have suction equipment available. You may need to clear the airway frequently of blood, saliva, or vomitus. Assure that the airway is open without using the head-tilt method. If movement of the head is necessary to restore an adequate airway, use the jaw-thrust maneuver.

b. **B - Breathing.** If needed, administer oxygen in high concentration to any patient with marginally effective respirations. (The spinal cord injury may have resulted in edema to the cord. If the necessary oxygen is not delivered, cell death can occur).

c. **C - Circulation.** Support and monitor the patient's cardiovascular system.

d. **C - Cervical Spine Stabilization.** Be sure the patient's head and neck have been temporarily stabilized. (This should have been done when his injuries were being assessed.

e. **C - Consciousness.** Determine the patient's level of consciousness. Use the Glasgow Coma Scale.

f. **Control Bleeding.** Control bleeding to prevent the loss of blood volume, a possible life-threatening condition.

(1) Administer an IV of lactated Ringer's solution.

(2) Apply medical anti-shock trousers (MAST), if necessary. Bleeding can sometimes be controlled with MAST garments, depending on the location of the injury and the cause of the bleeding. MAST garments are considered to be an intermediate life support measure. The garments are used to create a pressure against the flow of blood thus stopping bleeding.

g. **Cover Patient.** Keep the patient covered. The patient cannot conserve heat because his body has lost sympathetic tone and blood vessels and arteries have lost their vasoconstriction.

h. **Seizures.** Be prepared for seizures. Ordinarily, you would not restrain a patient having a seizure. A patient with a spinal cord injury must not move his head and/or neck very much. Therefore, such patients must be restrained during a seizure.

i. **Immobilize the Patient on a Long Back Board.** Depending on the accident and the position in which the patient is found, he may first need to be splinted onto a short spine board or Kendrick extrication device. With his head, neck, and back stabilized, the patient can then be placed on a long back board.

j. **Neurological and Vital Sign Checks.** Make frequent neurological and vital sign checks on the patient. Record the results.

5-19. COMPLICATIONS OF SPINAL CORD INJURY

a. **Impaired Breathing as a Result of Spinal Cord Injury.**

(1) Why this happens. High in the neck (at C3, C4, and C5), motor nerves to the diaphragm branch off the spinal cord. These cervical nerves are not usually injured by fractures or dislocations of the cervical spine. If the spinal cord is damaged at the mid-cervical or upper thoracic level, the corresponding motor nerves will be paralyzed, causing paralysis of the muscles of the abdomen, arms, and legs. Injury to the mid-cervical and/or upper thoracic motor nerves can interrupt or diminish normal respiratory muscle innervation (nerve supply to a structure or area). A severe injury prevents supporting muscles from assisting with breathing (the higher the injury, the greater the disability). Less severe upper-cord injuries may diminish respiratory drive, possibly causing atelectasis (a shrunken and airless state of the lung or a portion of the lung) and pneumonia.

(2) Effect on breathing. The patient may appear to be panting and having respiratory insufficiency. That is, he is not taking in enough oxygen for his body's needs. What has happened is that the spinal cord injury in paralyzing the chest wall muscles and the abdominal muscles has caused the patient to breathe only with his diaphragm. The motion of the diaphragm causes the abdomen to move in and out with each respiration. If the diaphragm cannot take in enough oxygen, the patient may pant in order to take in more air.

(3) Treatment. Monitor the patient's respirations. Give oxygen-enriched air to a patient with weak respirations.

b. **Neurogenic Shock.**

(1) Description. Neurogenic shock is the result of paralysis of the nerves that control the size of the blood vessels. A paralyzed patient's arteries and veins dilate (increase in size), especially in the abdomen and the lower extremities. Bigger arteries and veins allow more blood to move through the circulatory system, decreasing the patient's blood pressure. If not enough blood is returned to the heart, the patient's circulatory system may fail.

(2) Treatment. Follow this treatment:

(a) Splint the patient's spine by placing him on a long spine board.

(b) Put the patient in the shock position (Trendelenburg position). In this position, the foot of the long spine board is elevated about 12 inches. This elevation helps blood drain from the enlarged blood vessels in the abdomen and the lower extremities, returning the blood to the heart for circulation.

CAUTION: DO NOT elevate the foot of the spine board too much. If the board is elevated too much, the patient's bowels and other abdominal viscera may fall against the underside of the diaphragm and compromise the patient's breathing mechanism.

Section III. IMMOBILIZATION TECHNIQUES FOR SPINAL CORD INJURY

5-20. INTRODUCTION

A patient who has or who may have a spinal cord injury must be moved carefully. He must be moved without causing him further injury, pain, or discomfort. Included in this section is information on the cervical collar and three patient-carrying devices: the Kendrick extrication device (KED), the short spine board, the long spine board, and the scoop stretcher.

5-21. CERVICAL COLLAR (C-COLLAR)

The purpose of the cervical collar, also called the C-collar, is to stabilize the head and neck thus preventing further injury to the patient's spine. The collar should be rigid such as the stiff neck collar. This collar has enlarged openings in front to allow for pulse examination, observation of tracheal deviation, and prevention of constriction of the jugular vein. A soft cervical collar is ineffective in immobilizing the neck.

a. **Indications for Cervical Collar Use.** Use a C-collar for a patient who has signs or symptoms of spinal injury. Also, apply a cervical collar on a patient when the mechanism of injury suggests possible spinal injury.

b. **Procedure for Applying the Cervical Collar.** Follow this procedure:

(1) Manually stabilize the patient's head and neck by:

(a) Holding his head firmly, placing each hand around the base of his skull, supporting the patient's mandible and occiput.

(b) Using gentle traction to lift the patient's head to an "eyes forward" position.

(c) Immobilizing the patient's head in the same position in which he was found if the patient resists movement or feels more pain when his head is moved.

CAUTION: DO NOT twist or excessively flex or extend the patient's neck.

(2) Be sure the collar is the proper size. If the collar is too small, there will be pressure on the patient's airway, and he will be immobilized ineffectively. If the collar is too large, the patient's neck will be hyperextended excessively.

(3) Apply the cervical collar like this:

(a) The first rescuer maintains traction and immobilizes the patient's head.

(b) At the same time, the second rescuer slides one end of the collar under the small of the patient's neck and connects both ends of the collar together. Most collars have velcro closures.

5-22. KENDRICK EXTRICATION DEVICE (KED)

The Kendrick extrication device is one of the pieces of equipment that can be used before the patient is placed on a long spine board. The KED is used to immobilize a patient with possible spinal cord injury. The device can be slipped behind a patient who is found seated in a bucket seat, a short compact car seat, a seat with a contoured back, or in a confined space. The KED can also be used in places too confined for a short spine board to be used to stabilize the patient's head and torso.

Figure 5-3. The Kendrick extrication device.

Figure 5-4. The Kendrick extrication device applied to a patient.

a. **Indications for Use.** Generally, a KED is used to prepare patients with suspected spinal injuries for extrication and/or movement from a sitting to a supine position. As noted in the previous paragraph, the KED is used where the short spine board could not be used.

b. **Procedure for Applying the KED.** Follow this procedure:

(1) Open the KED and place it between the patient's buttocks and the seat he is on.

(2) Center the KED on the patient and position the KED snugly under the patient's armpits.

(3) Place padding under the small of the patient's neck.

(4) Fasten the chest straps. Snug up the bottom and the middle straps.

(5) Secure the leg straps like this:

(a) Slide the straps under the patient's thighs.

(b) Cross the straps at the crotch.

(c) Secure the straps at the opposite side. (Local protocol may vary on this point.)

(d) Use padding and be especially careful with male patients when applying the leg straps. Take care not to involve the penis when securing the leg straps.

NOTE: The American College of Surgeons Committee on Trauma decided in 1977 to remove the use of chin straps from patient immobilization protocol. Difficulties in comfortable patient immobilization followed. The horse-collar and horseshoe blanket technique provide firm stability to cervical injuries. Both allow the patient comfort through good padding.

(e) Tie the patient's hands together prior to movement.

c. **Placement of the Patient on the Spine Board.** Follow this procedure:

(1) Both rescuers grasp the side handles on opposite sides of the KED. Place their other arms under the patient's legs.

(2) Locking their arms together under the patient, the rescuers lift the patient up (keeping the patient's legs at a 45 degree angle). The rescuers then lower the patient onto a spine board.

NOTE: Another method of moving the patient to a spine board is for the rescuers to pivot the patient around in the seat and lower him onto a spine board placed inside the vehicle on an adjacent seat.

(3) The rescuers loosen the leg straps and lower the patient's legs until the patient is flat on the board.

5-23. SHORT SPINE BOARD

a. **Indications for Use.** Indications for use are the same as for the Kendrick extrication device. The short spine board is rarely used now due to the presence of superior equipment such as the KED.

b. **Procedures.** Follow this procedure:

(1) Apply the cervical collar and immobilize the head manually.

(2) Place the short spine board between the patient and the seat. Center the board.

(3) Secure the patient's trunk to the spine board with two straps.

(4) Place support material around the patient's head and neck. For example, a rolled blanket or clothing can be used as support material.

(5) Secure the patient's head to the board with a strap around the patient's forehead.

(6) Move the patient onto a long board.

(7) Both rescuers position themselves on opposite sides of the patient. Rescuers each place one arm around the back of the board and the other arm under the patient's thighs. The rescuers lock arms.

(8) Rescuers may turn and lower the patient onto a long spine board. Or, the rescuers may lift the patient out of his seat and lower him onto a long spine board.

5-24. LONG SPINE BOARD

The goal is to secure the patient to a long spine board as soon as possible so that he can be evacuated without further injury.

a. **Indications for Use.** Indications that a patient should be secured to a long spine board include:

(1) Suspected spinal injury.

(2) Patient who requires (or may require) a firm surface for the performance of CPR; for example, a patient who is both pulseless and potentially unstable.

b. **Procedure.** Procedure for securing a patient on a long spine board varies according to the position of the patient. The patient may be in a supine position, a recumbent position, or a sitting position. Follow this procedure for patients in the supine position at ground level:

(1) Position the spine board parallel to the patient.

(2) Rescuers position themselves along the side of the patient, opposite the spine board.

(a) If there are four rescuers available, rescuer #1 supports the patient's head. Rescuer #2 supports the patient's shoulders. Rescuer #3 supports the patient's pelvis, and rescuer #4 supports the patient's legs.

(b) If there are three rescuers, rescuer #1 supports the patient's head. Rescuer #2 supports the patient's shoulders. Rescuer #3 supports the patient's legs.

(3) Logroll the patient onto the spine board in this manner:

(a) Rescuers alongside the patient gently roll him toward them onto his side. Rescuer #1 supports the patient's head during the move. Rescuers roll the patient's body as a unit.

(b) One of the rescuers alongside the patient pulls the spine board into position against the patient.

(c) Again, rolling the patient's body as a unit, the rescuers roll the patient onto the spine board. Rescuer #1 still supports the patient's head as part of the body unit during the move.

(4) Pad the patient's head.

(5) Secure the patient's trunk and lower extremities with three straps positioned at the patient's chest, pelvis, and the knees.

(6) Immobilize the patient's head with a forehead strap.

5-25. SCOOP STRETCHER

A scoop stretcher is a metal stretcher which disassembles into a right and left half. These halves are assembled around the patient. The advantage is that this piece of equipment allows for spinal immobilization with minimal patient movement.

a. **Indication for Use.** A scoop stretcher can be used in these instances:

(1) A patient with a suspected spinal injury.

(2) Special rescue situations requiring vertical movement of the patient.

(3) A patient with a fractured pelvis.

b. **Procedure.** Follow this procedure to use the scoop stretcher:

(1) Apply the cervical collar and manually immobilize the head and neck (for patients with suspected spinal injury).

(2) Adjust the stretcher to the length of the patient.

(3) Separate the stretcher into right and left halves.

(4) Position the stretcher halves on opposite sides of the patient.

(5) Slightly log roll the patient away from you and slide the stretcher half under the patient on both sides.

(6) Assemble the head end of the stretcher.

(7) Logroll the patient toward you while the other rescuer brings the foot ends of the stretcher together and latches them in place.

(8) Pad the patient's head.

(9) Secure the patient's trunk and lower extremities with three straps positioned at the patient's chest, pelvis, and the knees.

(10) Immobilize the patient's head with a forehead strap.

Section IV. MANAGEMENT OF SPINAL CORD INJURY

5-26. COMMON ERRORS IN MANAGEMENT

Remember that the goals in treating a patient with a possible spinal cord injury are to support the patient's vital functions (airway, breathing, and circulation) and to keep the patient from sustaining more injury. Improper management of the patient can result in permanent, nonreversible, devastating injury. Look at these common errors in managing a patient with a possible spinal cord injury.

a. Too much reliance on soft collars.

b. Improper use of chin straps. Use of chin straps are only beneficial if the mouth is closed and molars seated. The patient may vomit and aspirate; therefore, avoid using chin straps.

c. Ineffective immobilization, such as the following:

(1) Devices not properly anchored.

(2) Ties applied around the legs, allowing the device used to move if the legs of the patient move.

(3) Patient's head not immobilized properly.

(4) Patient's feet not tied together.

d. Patient's head in an improper position. Avoid hyperextension, overpadding, or collars which are too large.

e. Lack of concern for other injuries when applying an immobilization device.

f. Immobilization of the patient's chest inhibiting ventilation.

g. Patient is moved too much when the immobilization device is applied.

h. Rotary stress placed on the patient when the straps are being tightened, etc.

i. Immobilization of the patient's head before the patient's trunk is immobilized.

j. Sandbags are used with a long spineboard.

k. Short board is not used properly in conjunction with the long board.

l. Too much time is spent mechanically immobilizing the patient's spine when intervention for other injuries is needed.

5-27. CLOSING

Young, otherwise healthy people suffer a high percentage of spinal cord injuries and head trauma. The results of such injuries are often devastating. Quick recognition and proper, early management of spinal injuries can make a significant decrease in such injuries.

Continue with Exercises

EXERCISES, LESSON 5

INSTRUCTIONS. The following exercises are to be answered by writing the answer in the space provided or by selecting the proper term. After you have completed all the exercises, turn to Solutions to Exercises at the end of the lesson and check your answers.

1. What is the meaning of the term pathophysiology? _____

   _____.

2. Most brain injuries occur due to movement of the _____ inside the skull.

3. List four possible bodily responses to brain injury.

   a. _____

   b. _____

   c. _____

   d. _____

4. As intracranial pressure rises to progressive level one, blood pressure (rises/falls) and the pulse (increases/slows). The patient's pupils are (small/large) but react to light. His respiratory pattern is (normal/abnormal).

5. In progressive level two as the intracranial pressure rises, blood pressure (increases/decreases). The pulse rate (increases/decreases). The pupils become fixed at _____ mm. The respiratory pattern is (fast/slow).

6. Complete these statements or answer the questions which refer to progressive level three of rising intracranial pressure:

   a. Pupils of the eyes of a patient in this level are _____.

   b. The patient's respiratory rate is _____.

   c. Is there a response to painful stimuli? _____

   d. The patient's pulse is _____.

   e. The patient's blood pressure is _____.

7. Anoxic brain injury is _____

   _____

8. Why does a scalp wound (even a minor laceration) bleed profusely?

   _____

   _____

   _____

9. To stop bleeding from a scalp wound, _____

10. List four signs/symptoms of skull injuries.

    a. _____

    b. _____

    c. _____

    d. _____

11. List four elements in the treatment of skull fractures.

    a. _____

    b. _____

    c. _____

    d. _____

12. A concussion is _____.

13. What is the most important indication of concussion? _____

    _____

14. A bruise in the brain, the bruise consisting of a superficial focus of brain hemorrhage, necrosis, and/or laceration is the definition of _____.

15. Complete the following statements regarding contusions.

    a. A coup contusion is _____

    _____

    b. A contrecoup contusion is _____

    _____

16. Name the condition that is the most common cause of preventable death following a head injury. _____

17. A blood-contained swelling within the cranium is the definition of the condition

    _____.

18. An acute epidural hematoma is _____

_____

19. An acute subdural hematoma is _____

_____

20. The Glasgow Coma Scale defines the level of a patient's consciousness according to three functions. These functions are:

    a _____

    b. _____

    c. _____

21. Part of a neurological examination is an examination of the patient's pupils for equality and reaction to light. List four abnormal reactions in this area:

    a. _____

    b. _____

    c. _____

    d. _____

22. A patient with a total point count of 9 to 12 points on the Glasgow Coma Scale as (what level) _____ head injury

23. When evaluating a patient with a head injury, always assume that the patient may also have a _____ injury and a _____ injury.

24. AVPU refers to the initial assessment of the head injury patient's responsiveness or unresponsiveness. What do the letters AVPU stand for?

    a. A _____

    b. V _____

    c. P _____

    d. U _____

25. Detection of spinal injuries can be difficult. Additionally, a patient with a spinal injury may or may not have signs/symptoms characteristic of that injury immediately. Therefore, it should be assumed that any patient who is

    _____may have spinal injury.

26. The two terms paralysis and paresis do not have the same meaning.

    Paralysis is _____

    Paresis is _____

27. Is this statement TRUE or FALSE? A patient who can move his extremities or who has no signs/symptoms of numbness, tingling, or other neurological damage does not have a spinal cord injury.

    _____

28. List three types of spinal cord damage which can be the direct result of an accident.

    a. _____

    b. _____

    c. _____

29. The mechanism of injury for a spinal cord injury caused by a sudden excessive compression which drives the weight of the patient's body against his head is termed _____.

30. Gunshot wounds to the chest, back, and abdomen may cause tears in the spinal cord. The mechanism of injury operating here is termed _____.

31. There are some circumstances in which it should be assumed that the person has a spinal injury regardless of whether there are signs/symptoms of such injury. List five such circumstances.

    a. _____

    b. _____

    c. _____

    d. _____

    e. _____

32. In the initial quick assessment of a patient with possible spinal cord injury at the scene of an accident, you should obtain information in five areas. List these areas.

    a. _____

    b. _____

    c. _____

    d. _____

    e. _____

33. When you are assessing the injuries of an individual with a spinal cord injury, the _____ survey is a rapid examination to determine the patient's condition. The _____ survey is a head-to-toe, indepth examination using the look, listen, and feel techniques to evaluate the body by sections.

34. What is the goal of initial treatment for spinal cord injury?

_____

_____

35. If a patient with a spinal cord injury is handled improperly, what can happen?

_____

36. What is the cause of impaired breathing from a spinal cord injury?

_____

_____

_____

37. Spinal cord injury can sometimes result in the paralysis of nerves that control the size of blood vessels, a condition termed _____.

38. The purpose of a cervical collar in treating a patient with a spinal cord injury is to

_____

_____

39. Generally, when would you use a Kendrick extrication device on a patient with a possible spinal injury?

_____

_____

40. A metal stretcher which disassembles into a right and a left half is called a

_____

41. List five common errors in managing a patient with spinal cord injury.

a. _____

b. _____

c. _____

d. _____

e. _____

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 5

1. Pathophysiology is the physiology of disordered function. (para 5-3)

2. Brain. (para 5-3b)

3. You are correct if you listed any four of the following:

   Swelling of the brain.
   Build-up of carbon dioxide.
   Hyperventilation.
   Unconsciousness.
   Increased intracranial pressure (ICP). (paras 5-3c(1) through (6))

4. Blood pressure rises.
   Pulse slows.
   Pupils small.
   Respiratory pattern is abnormal. (paras 5-4b(1)(a) through (d))

5. Blood pressure decreases.
   Pulse decreases.
   Pupils fixed at 3 to 5 mm.
   Respiratory pattern fast. (paras 5-4b(2)(a) through (e))

6. a. Pupils fixed and dilated.
   b. Respiratory rate erratic or absent.
   c. Response to painful stimuli - no.
   d. Pulse rapid and irregular.
   e. Blood pressure decreased. (paras 5-4b(3)(a) through (g))

7. Anoxic brain injury is injury to the brain from lack of oxygen. (para 5-5)

8. A scalp wound bleeds profusely because there are many blood vessels in the scalp and some of these blood vessels are close to the surface. (para 5-6a)

9. Apply direct pressure. (para 5-6a)

10. You are correct if you listed any four of the following:

    Patient is unconscious or has an altered level of consciousness.
    Patient has a deep laceration or severe bruise to the scalp or forehead.
    Patient has severe pain or swelling at the site of the head injury.
    Patient's skull has a deformity; for example, a depression or an unusual look to the cranium's shape.
    Patient has a bruise or swelling behind an ear.
    Pupils of patient's eyes seem unequal in size.
    Tissue around or under both of the patient's eyes seems discolored.
    One of the patient's eyes seems sunken.
    Patient is bleeding from the ears and/or the nose.
    Clear fluid is flowing from the patient's ears and/or under the nose.
    (paras 5-6b(1)(a) through (j))

11. You are correct if you listed any four of the following:

    Assure/maintain open airway.
    Resuscitate.
    Keep patient at rest.
    Control bleeding.
    Monitor patient's vital signs.
    Dress/bandage open wounds.
    Keep conscious patient alert.
    (paras 5-6b(2)(a)1 through 7)

12. A concussion is a mild state of stupor or temporary unconsciousness caused by a blow to the head. (para 5-6c)

13. The most important indication of concussion is memory loss for the exact moment of injury. (para 5-6c(1)(b))

14. Cerebral contusion. (para 5-6d)

15. a. A coup contusion is a contusion that occurs in the part of the brain that is directly under the focus of an impact. (para 5-6d(1)(a))

    b. A contrecoup contusion is a contusion that occurs in areas of the brain that are remote from the focus of the impact. (para 5-6d(1)(b)

16. Intracranial hematoma. (para 5-6e)

17. Intracranial hematoma. (para 5-6e)

18. An acute accumulation of blood between the dura and the inner surface of the skull. (para 5-6e(1))

19. An acute subdural hematoma is venous bleeding located between the dura and the brain. (para 5-6e(2))

20. Eye-opening.
Language function (verbal response).
Movement (motor response). (para 5-9a)

21. Pupils fixed and pinpoint.
Drooping upper eyelid when eyes are open.
One pupil dilated and fixed.
Both pupils dilated and fixed. (paras 5-7f(3)(b)1. through 4.)

22. Moderate. (para 5-9d(2))

23. Cervical spine.
Spinal cord. (para 5-7)

24. a. A -- Alert.
b. V -- Verbal response.
c. P -- Response to pain.
d. U -- Unresponsive. (paras 5-8a through d)

25. Unconscious. (para 5-12)

26. Paralysis is loss of movement.
Paresis is weakness or incomplete loss of muscular power. (para 5-12, NOTE)

27. FALSE. Absence of signs/symptoms of spinal cord injury only mean the patient's spinal cord is in tact so far. The patient may have an injury to the spinal cord, an injury which is difficult to detect. (para 5-13)

28. You are correct if you listed any three of the following:

Cutting of the spinal cord, complete or incomplete.
Pinching of the spinal cord.
Stretching of the spinal cord.
Compression fractures of vertebrae in the spinal cord.
Displacement of vertebrae, small or complete.
Bruise of the spinal cord.
Overstretching and other damage to ligaments and muscles involved in the spinal cord. (paras 5-13a(1) through (7))

29. Axial loading. (para 5-14a(1))

30. Distraction. (para 5-14d(2))

31. You are correct if you listed any five of the following:

    Mechanism of injury was violent.
    Patient has head injury.
    Patient is in an altered state of consciousness.
    Patient is in a state of unconscious trauma.
    Patient has significant blunt trauma above the clavicals.
    In the accident, there may have been sudden violent movement, deceleration of the spine, or there are signs of spinal injury.
    Patient was ejected from an automobile.
    Patient's helmet was damaged in a motorcycle or sports injury.
    Patient is experiencing pain when he moves and when he does not move.
    Patient has point tenderness surrounding the spine.
    Patient has deformity in neck.
    Patient protects his head, neck, or back.
    Patient has paralysis, partial paralysis, numbing, tingling.
    Patient has signs of vasodilation.
    Patient has gunshot wound between the neck and the pelvis.
    (paras 5-15a(1) through (13))

32. Mechanism of injury.
    Exact time of injury.
    Sensation felt by patient.
    Movement of patient.
    Patient's signs/symptoms. (paras 5-16a through e)

33. Primary.
    Secondary. (paras 5-17a(1), (2))

34. The goal of treatment for spinal cord injury is to support the patient's vital functions and to prevent further injury. (para 5-18)

35. The patient may become permanently paralyzed. (para 5-18)

36. Damage to the motor nerves at the mid-cervical level and the upper thoracic level can prevent supporting muscles from assisting with breathing. The patient's breathing may become impaired. He may develop atelectasis and pneumonia. (para 5-19a(1))

37. Neurogenic shock. (para 5-19b(1))

38. Prevent further injury to the patient's spine. (para 5-21)

39. To move the patient from a sitting position to a supine position; for example, from inside a car to outside a car. (para 5-22a)

40. Scoop stretcher. (para 5-25)

41. You are correct if you listed any five of the following:

Too much reliance on soft collars.
Improper use of chin straps.
Ineffective immobilization such as:
- Devices not properly anchored.
- Legs incorrectly tied.
- Patient's head improperly immobilized.
- Patient's head in an improper position.
- Lack of concern for other injuries when applying an immobilization device.
- Immobilization of the patient's chest, inhibiting ventilation.
- Patient moved too much during application of immobilization device.
- Rotary stress placed on patient during application of immobilization device.
- Patient's head immobilized before his trunk is immobilized.
- Sandbags used with long spineboard.
- Short board not used properly along with the long board.
- Too much time on mechanically immobilizing patient's spine when attention to other injuries needed. (paras 5-25a through l)

End of Lesson 5